GOOD GOVERNANCE FOR SUSTAINABLE SUPERIOR MANUFACTURING PERFORMANCE

A NOVEL MODEL, METHODOLOGY & ROADMAP

by

A M Singhvi

A Thesis submitted to Middlesex University
in partial fulfilment of the requirements for the degree of
Doctor of Engineering

ADVANCED MANUFACTURING & MECHATRONICS CENTRE
SCHOOL OF ENGINEERING SYSTEMS
MIDDLESEX UNIVERSITY

August 2002

Acknowledgement

There are many people to whom I wish to extend my most grateful thanks.

To Mr. L.B. Heath of May & Baker (now Aventis), Mr. M.J. Rigby of Coca-Cola, Mr. J. Stout of BICC, Mr. J. Sheehan and Mr. R.J. Hancock of British Leyland, Mr. D.R. Edwards of GEC-Alsthom, Mr. D. Gadd and Mr. Alex Hayes of Alstom, Mr. J. Leger and Mr. D. Long of Carnaud Metalbox. Their advice has been greatly appreciated.

To my Director of studies, Prof. Tony White and Supervisor Prof. Raj Gill, for their enthusiastic support and kind guidance.

To my Industrial Collaborators Dr. Brij Mohan Kathuria and Mr. Surendra Singh Maru for their practical advice.

I also wish to extend my thanks to Mr. Stephen James Watt, Research Administrator of Middlesex University for useful and timely feedback.

ABSTRACT

In the rapidly changing global scenario, it became increasingly clear that new thinking was required to make businesses competitive given the challenges of liberalised trade regimes, free flow of capital and knowledge. The prodigious marriage of computers, communications and technology provided lot more options to the consumers, competitors, employees, suppliers and providers of money alike. Customers and Consumers have become more demanding, not only in terms of product quality or costs but also innovations and defect free services.

The Author, anticipating the change, advised the Chairman of the Aditya Birla Group, (with sales and assets in excess of 6 billion US dollars and having manufacturing sites in India, Thailand, Philippines, Thailand, Malaysia, Indonesia, Egypt and Canada), to focus on lifting the standards of Manufacturing in all his Units. The Author joined the Group in late 1996 as the President of World Class Manufacturing. a Corporate Function, as a direct reporter to the Chairman

Some companies in the Group, which are making good profits, perceived themselves as World Class since they had obtained ISO Certification, and a few other Awards. Yet others were pursuing customers with their own definition of quality, costs and delivery. And some were pursuing improvement programs under external consultant's guidance. The business went on as usual, except more explanation of how competition was increasing, and generic statements like "we are doing all we can to deal with the situation which should improve soon"

It was in the above context that Author thought of trying holistic approach for Good Governance at all levels, at all locations, involving all employees and all activities with focus on Manufacturing since best of marketing efforts would be in vain if not backed up by a World Class product with right cost and delivery. Anticipating the future needs, Author wanted everyone to focus on Innovations and Intellectual Capital and highest levels of Productivity from the six Ms [we call it. Men or Women (People), Material, Machines, Methods, Measurement and Markets].

After studying current literature and case studies on the subject and interacting with his

former employers in Europe, America, Africa and Asia, and his potential customers (the 67 Plants in 1997) Author devised a Model that was futuristic, holistic, simple to be understood as the '**Art of Managing the Workplace**', small or big. This was supported by a detailed Road Map and Methodology for Implementation of the Revolution for Excellence in the Group. A set of unique actions that would change the Mindset and Inspire the troops were developed and applied. Each of the 67 Plants have developed and deployed its own actions for percolating the philosophy, concept, tools and technique for the Deployment, Assessment and Review for becoming a world class manufacturer (WCM)

The results are most satisfying as, the Model, its Road Map and Methodology with actions for Sustaining the Momentum has led to significant improvements in Products, Processes, Mindset and Culture of the People; they have attained higher knowledge level in their work, become extremely customer focused and have sent positive signals to all the stakeholders about their ability to protect the future, enhancing the competitiveness of their business, and therefore the Nation, and thereby protect the future of the next generation of employees, investors as well as other stakeholders.

The tangible savings (over a period of approximately 5 years) in both Indian rupees and UK Pounds Sterling are summarized here under.

On an average there are savings of about 9.5 millions UK £ per year. The turnover of the group is about 5500 millions UK (£). The savings thus comes equivalent to about 0.2 % of the Group's turnover which is a substantial amount creating a big impact on bottom line.

S.No.	Dimension	Savings: INR (in Lakhs)	Savings: UK £ in millions
1.	Kaizens	19043.0	26.66
2.	Waste Elimination	12093.9	16.93
3.	Quality Improvement Projects	1578.9	2.21
4.	5S	500.0	0.70
5.	MP Design	458.4	0.64
6.	JIT	282.9	0.40
7.	COQ	163.8	0.23
	Total	**34120.9**	**47.77**

Brief Profile of Aditya Birla Group

- o India's largest business house
- o Operating in India for over 6 decades
- o Operating globally for nearly 30 years
- o 67 nos. state-of-the-art manufacturing units
- o 1,10,000 nos. employees
- o 7,00,000 nos. shareholders
- o Operating in 18 countries (including :-Thailand, Indonesia, Malaysia, Philippines, Egypt, Canada, USA & UK)
- o The world's largest producer of viscose staple fiber.
- o Amongst largest producer of white cement.
- o The largest single location refiner of palm oil.
- o The third largest producer of insulators.
- o The fifth largest producer of carbon black.
- o Amongst the lowest cost producers of aluminum globally.
- o The largest fully integrated aluminum producer in India.
- o In India, the group is single largest producer of viscose filament yarn, gray cement (at single location), white cement and rayon pulp, the only producer of linen and a leader in the ready-to-wear branded apparel.

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OUTLINE OF THE THESIS

The **Aditya Birla Group of India** is adapting unified and unique Corporate Strategy based on the concept of World Class Manufacturing introduced to the world by Richard Schonberger about 20 years ago under the Author's guidance for achieving manufacturing excellence and given it brand name - World Class Manufacturing (WCM). It targets excellence in manufacturing by delighting the Customers, Employees and other Stakeholders on a sustainable basis. This strategy has been successfully implemented in 40 Units of Aditya Birla Group of Companies. (A brief profile of Aditya Birla Group has already been reflected in the **'Abstract'**)

Chapter-1 gives glimpses of some of very prominent factors which inspired the Author to look the Business Operations in a unique approach incorporating solutions to most of the present constraints. The changing scenario, unprecedented uncertainty posing competitive struggle and dwindling natural resources have led the Author to visualize a comprehensive solution. The need and outcome of Research and Development evolving various Excellence Models have been briefly dealt in this chapter.

The **term WCM** has been coined about 20 years ago when Dr. Schonberger used the phrase "World Class Manufacturing". Some other authors such as Norman Gaither, Ronald Moore and others have used the phrase World Class Manufacturing (WCM)". Probably these authors intended to include a manufacturing scenario which resulted in production of highest quality products at a low cost, which could be competitively marketed in the European and other sophisticated markets.

Chapter-2 describes various quality initiatives. The **author** has developed his own model for World Class Manufacturing taking a cue from the initiatives like; Total Productive Maintenance (TPM) and other Quality and Customer related initiatives like TQM, TQC, BPR, TPS. The Author has proposed a QCDIP (Quality and Quantity, Cost, Delivery, Innovation & Productivity and Pride) Model to fulfill the philosophy of World Class Manufacturing.

Chapter-3 deals with **WCM Model**, its Concepts, Approach, Methodology and Implementation in detail. This chapter also deals with the Tools & Techniques such as; Visual Management & Controls, Time Management, Problem Solving Tools such as: Why– Why Analysis; PM Analysis: Brain Storming; Cause & Effect Analysis; FMEA (Failure Mode Effect Analysis);

PDCA Cycle; Flow Diagram; Value Engineering, SMED (Single Minute Exchange of Dies)/ Quick Changeover, Benchmarking, One Point Lesson, Zero Abnormality Movement (ZAM), Multi-Skilling etc under the Methodology.

The Methodology comprises of three steps: Forming the Teams, Equipping the Team - with WCM Tool & Techniques, and Mindset & Culture, and Visual Competition amongst the Teams. The implementation process necessitates development of a suitable WCM Facilitating Structure that sees to it that various tenets of WCM are efficiently implemented and successfully completed. People in WCM facilitating structure make use of 17 Steps Master Action Plan in order to implement the WCM initiatives in a structured manner. WCM is launched in a Unit with Two Days Conference cum Workshop in order to Build Top Management Will. For Sustaining the Momentum, various activities are carried out at Unit and Corporate Level.

Chapter–4 is a presentation of Tangible and Intangible results which reflects the achievements accrued from the application of WCM.

Chapter–5 highlights the relationship and comparative analysis of WCM with other contemporary Quality and Manufacturing procedures, initiatives and management techniques. With so many initiatives existing across the Globe today it becomes imperative to have an initiative which covers the major aspects of all initiatives without compromising on its own uniqueness. WCM is one such initiative. The comparison of WCM Excellence Criteria has been made with other National/International Award criteria and presented in **co-relation matrix.** The intent of this chapter is to underline the novelty of Author's WCM Model. It is meant to explain at a glance, the Philosophy, the Major Highlights, Implementation Methodology of WCM and Future Intentions. The author firmly believes that his philosophy if followed diligently should result in a spiral of increasing Productivity and better Quality life of the people of the World.

Chapter-6 Throws light on the Award Road Map and fairly covers the assessment criteria and process.

References- Wherever found suitable in all above chapters, the references have been mentioned in Blue colour. A list of these references has been annexed after chapter-6 in Blue colour.

CHAPTER-1

INTRODUCTION

1.1 THE BACKGROUND

In the early 20th century, the business corporations were viewed solely as economic institutions with certain limited economic responsibilities, such as producing goods and services to satisfy consumer needs, generating employment for much of the nation's workforce, paying suitable dividends to the shareholders and making appropriate provisions for future growth. Similarly, getting appropriate return on investment, maintenance of satisfactory cash flow, gaining expected market share, achieving product leadership, and making proper technological review were considered to be the important goals for a business corporation. It was considered that the achievement of these goals would ensure continuous existence of a business corporation as a viable and independent economic entity. If these goals were achieved and earlier narrated responsibilities were fulfilled, then it was considered that a business corporation has successfully discharged its obligation to the society. It was also considered that such business corporations have made their desirable contributions to the society's wealth.

"During the last several years, there has been a dramatic change in the environment in which the business functions. New roles have been defined for businesses to perform in society as an increasing amount of attention has been devoted to issues such as pollution control, workplace safety and health, equal opportunity, and product quality and safety. The changing complexion of business environment carried long term impacts and brought dramatic changes in the 'rules of the game' by which business is expected to operate". (Refer book: Buchhold R.A. (1989), *Business Environment and Public Policy: Implication for Management and Strategy Formulation*, Prentice Hall, Englewood Cliffs, New Jersey).

"Taking risks, breaking the rules, and being a maverick have always been important, but today they are more crucial than ever. We live in a discontinuous world – one where digitisation, deregulation and globalisation are profoundly reshaping the industrial landscape".– Gary Hamel

The most significant requirement of the changing business environment is to remain aware of the events taking place on the concerned socio-economic scenario. In this regard the profile of recent changes in business environment has been very carefully designed by observing, "Stock market crashes, political assassinations, declarations of war, and oil shocks are the sorts of events that trigger social or economic upheavals. Dawning awareness, on the other hand, tends to usher in modest change instead of upheaval." (Refer book: Schonberger Richard J. (1986), *World Class Manufacturing: The Lessons of Simplicity Applied*, The Free Press, New York.)

Thus, while drafting their business policy and Corporate Strategies, the respective business house must remain 'aware' about the profile of business environment influencing its survival and growth.

It has been appropriately observed, "Of the forty-three excellent companies only fourteen could be considered excellent five years later." Similarly, "Of the corporations in the Fortune 500 ranking five years ago, 143 are missing today"- Richard Tanner Pascale, (1990). This signifies that business corporations that are not properly aware of the impact of changes in business environment and fail to change their approaches towards utilizing and managing their human and non-human resources accordingly are likely to face very critical and difficult time in the future. Thus, it will be no exaggeration to claim that business corporations will require new approaches in the new millennium. In other words, it can be stated that corporate approaches today will be significantly different than the corporate approach tomorrow.

Some of the Typical Characteristics of Today's Business Environment:

1.1.1 Scarcity of Specific Resources (Human and Non-Human Resources)

The resources referred here include both *'human and non-human resources'*. Corporate leaders are required to undertake several organised researches and develop close association with several National and International agencies supplying these resources.

Beside acquisition of resources, it also requires their rational use. This mainly depends upon the identification of appropriate processes for using these resources and managerial directions to subordinates for rational use of resources. It will require specific training to managerial and non-managerial human resources by which they can learn appropriate and rational use of

resources. Similarly, it will also require development of cordial relationships between managerial and non-managerial human resources and their complete commitment towards achieving excellence in the business operations of the corporation. In other words, the managerial and non-managerial human resources will be required to develop loyalty to the organisational goals. They will have to work with their maximum efficiency and demonstrate their willingness to contribute their maximum efforts for achieving excellence in all business operations. The corporate leaders will have to specifically identify the improper and misuse of corporate resources. They will have to train their workforce to prevent it and ultimately save scarce corporate resources. It is expected that this will significantly reduce the cost of production of goods and services and their distribution. This will add to the profit margin of the corporation. This is very easy to state but very difficult to do. This will require complete change of mindset of the entire workforce of the corporation. In other words, it will be a '*complete mental revolution*'.

1.1.2 Workforce Diversity

The global economy has expanded the scope for workers to chase job opportunities across national boundaries. Similarly, most of the business corporations around the world have now realised that no one society has a monopoly on the talented human resources. Now, it is considered that these human talents are spread equally in all societies of the globe. Since every business corporation is making a campaign for acquiring best human talents from various parts of the world for operating their business functions in highly efficient manner, there is a very tough competition between various corporations in this regard. The new approach of corporate leaders for acquiring human resources from different parts of the world has created a typical situation in the corporate world. It brings in people belonging to different traditions, cultures and creates '*workforce diversity*' in the composition of corporate workforce. The impact of '*workforce diversity*' can be understood by realising that it emerges on account of different people belonging to different societies of one country or people belonging to different societies of different countries working together in a business corporation. Today, most of the business corporations are experiencing both types of '*workforce diversities*'. The global economy has significant contribution in creating '*workforce diversity*' in a business corporation where different people belonging to different

societies of different countries work together and contribute their efforts for achieving a common organisational goal. The threat of mismanagement of '*workforce diversity*' can be explained by quoting an example. Sometimes, the management may consider straight forward and open communication style to be proper but a section of workforce representing different culture may consider it to uncomfortable and threatening. Appropriate management of *'workforce diversity'* has become an important managerial issue in United States of America, Canada, Australia, Japan, South Africa and several European and Asian countries (including India). The business corporations are making serious efforts to effectively manage the negative aspects of '*workforce diversity*'.

It may be particularly understood that several heterogeneous groups in a corporate workforce will have different needs, aspirations and attitudes. This has to be properly managed. It may not be an exaggeration to state in this regard that corporate managers will require specific *'diversity–training'* and '*revamping benefits'* to become able to work with people from different cultures.

"If you think training is expensive, consider the price of ignorance". (Refer book: S. Abdul Majeed & Co., (1996), *Total Quality,* The Executive Guide to the new way of doing business.)

Managers will need to shift their philosophy from treating everyone alike to recognising differences and responding to these differences in ways that will ensure employee retention and greater productivity; while at the same time not discriminating. In this regard, it deserves a specific mention that more than 50% of 500 fortune companies implemented a policy to comparatively provide more salaries and other service benefits to those managers who are able to effectively manage the *'workforce diversity'*. This clearly signifies the importance of managing workforce diversity in the present context.

It is suggested that if '*workforce diversity*' is properly managed, it adds to creativity, innovation and effective decision making process in the business corporation. In this regard it has been appropriately explained, "Diversity, if positively managed, can increase creativity and innovation in organisation as well as improve decision making by proving different perspectives on problems"- McLeod and Label, (1992). Similarly, it has been rightly highlighted by Robbins- "When diversity is not managed properly, there is potential for higher turnover, more difficult communication and more interpersonal conflicts". It has also been claimed that today's success of a business organisation depends upon its ability to effectively manage the '*workforce diversity*'. It has been appropriately stated in this regard, "Success in the new workplaces increasingly requires a set of skills for working successfully with a broad

mix of people from different ages and genders and of different domestic and national cultures," -Schermerhorn, Hunt and Osborn, (1997). The above explanation clearly signifies the importance of managing human resources in future business operations. It is properly found out as, " How to effectively manage human resources, becomes the key challenge, not only to compete but also to survive. The business corporations must understand and be able to apply innovative techniques to better manage their human resources"- Fred Luthans, (1995).

1.1.3 Emergence of New Customer

It has been appropriately claimed that in the new Millennium, the business world is confronted with a *'New Customer'*. This *'New Customer'* is more aware and better informed than his predecessors. The information revolution and customer's easy accessibility to information about alternative products and services for satisfying their needs will make this customer to be very difficult to handle by business corporations in this Millennium. Today, the customers have wide range of information that adds to competition for business corporations in selling their products and services. In other words, the information revolution has taken knowledge about alternative products and services to the homes of the users. Thus, there is almost complete elimination of seller's market and it has been substituted by the buyer's market. The buyers have become the most dominating force in the market. They have begun demanding value for the price that they pay for getting some product or service. They now want high quality of products, high standard of services and more so at the reasonable price. This has introduced a situation of cut-throat competition in the market. The business corporations are forced to focus on two divergent forces: high quality of products & services and reduction in their cost of production & distribution. The customer is likely to become more demanding in this Millennium. In this regard Luftman says "It is increasingly becoming important to understand customer's needs and wants, and to translate these into a unique value-added business mission. Companies capturing and applying information at each point of customer contact will, therefore, be better off than those do not." (Refer book: Luftman J. N. (1996), *Competing in the Information Age: Strategic Alignment in Practice*, Oxford University Press, Oxford.)

The business corporations will have to meet this challenge with more carefully designed

corporate strategies. The corporations that fail to do so will have to face a threat to their survival.

1.1.4 Unprecedented Uncertainty

All the evidences seem to indicate that most of the business corporations in future will have to operate in a world of unprecedented uncertainty. In times to come, the international environment is likely to become more complex and uncertain. The successful business corporations in the future will be ones that can deal effectively with a complex and uncertain environment. To do this, the business corporations will be required to constantly monitor and assess impacts of its environment. They should be ready to change their strategy to fit the changing environment. The proper responses to this uncertainty are flexibility, responsiveness, adaptability, mastering new technologies, proper organizational setting, and appropriate use of information-based-technology.

There is little doubt that globalization of business will continue in this century. For successful business operations, the international corporate players will also have to consider the global political climate. They will need to monitor and analyse changing political relationships in global context. One thing is certain in regard to international politics and ideologies and i.e. "nothing is certain and everything changes". The international business players should keep this fact in their consideration while formulating business strategies.

1.1.5 The Continuous Change

The change is a continuous process. The business environment is no exception in this regard. Thus, the complexion of business environment is also regularly changing and subsequently the business structures and processes are also regularly changing. It can be seen that the complexion of business environment significantly changed in the last leg of 20^{th} century. It is expected that it will further change more significantly in this millennium. In this regard, authors of the book 'World Class Manufacturing – A Strategic Perspective' says- "Organisations are at present in the midst of a revolutionary transformation: that of competition shifting from the *industrial age* to the *information age*". (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*,

Macmillan India Ltd., Delhi.)

Today, the world has become a '*global village'* in the true sense. It has witnessed dynamic replacements in the styles of operating and managing business activities. During this phase, the corporate leaders were forced to change their managerial styles and use their resources in the best possible manner. The corporate leaders were forced to do so because of certain changes in business environment such as, information revolution, rapid technological advances and global business operations within the framework of cut throat competition. The globalise-business operation has become the key to success and growth of business. This has been confirmed by a prominent management thinker with an observation, "The scenario is different now. Globalise or perish is the slogan now a days." (Refer book: Aswathappa K. (1996), *Business Environment for Strategic Management*, Himalaya Publishing House, Mumbai.) The information explosion will have tremendous implications in the field of management. In this regard it has been appropriately highlighted, "Another major environmental development is the second generation of the Information Age. It has moved to automated decision making, more technology – based telecommunication, and the so – called *'information superhighway'*. Decision support and expert systems and E-mail, putting every member of the organization in direct communication with everyone else, even around the world through INTERNET, have become common place. Such an information explosion has tremendous implications for the field of management"- Fred Luthans, (1995).

The '*change'* will have a tremendous impact on business corporations in this Millennium. In this regard it has been properly elaborated, " As we approach the new millennium, the only certainty is *'change.'* The dizzying rate of change and the accompanying uncertainty will continue to have a tremendous impact on organisations and the way they are managed" – Fred Luthans, (1995).

1.1.6 The Competitive Struggle

The arrival of unprecedented competitive intensity and accelerated pace of 'multidimensional changes'– the twin strategic constants of present times have completely changed the main pursuits of a business corporation into a '*Competitive Struggle'*. It has involved the patterns in which a business corporation uses its human and non-human resources. Now, the success of a business corporation mainly depends upon its ability for developing proper connection

between competition and performance of corporate resources. In this regard, it should be noted that the connection between external competition and internal performance – has always been there, and has always been the underlying basis for continued survival and success of the business corporation, but it has become more prominent in the present context. Today, a business corporation essentially requires its people to perform excellently within the corporation for successfully meeting the challenges of external competition.

1.1.7 Dwindling Natural Resources: A Threat to Survival of Humanity

The business is the most prominent user of the natural and other resources of the world. Thus, the manner in which natural and other resources are used by the business becomes one of the most crucial concerns of the society. Today, the business organizations have to perform new and well-defined roles in the society. Increasing amount of attention has been devoted to issues such as degradation of environment and increasing pollution. Environmentalists and conservationists have argued throughout the 20th century that humans would not survive long if they ignore their impact on the environment. In the late 20th century, people around the world have experienced the effect of continuing pollution and the dwindling of natural resources. These effects have included difficulties in disposing of toxic wastes, erratic weather conditions attributed to the Greenhouse Effect, a shortage of landfill sites for garbage disposal, and the evidence of cancers associated with chemicals in the air and food, among others.

If the evidence continues to mount that humans will not survive unless greater attention is paid to damage to the environment, then it is likely that more and more people will consider this as a serious issue and factor it into their purchasing and business decisions. The business corporations will have to appropriately assess their global operations relative to environmental issues. These issues will provide opportunities and challenges for international corporations – opportunities to develop new products and services in response to environmental problems and challenges associated with repairing damages created by current and past operations.

1.1.8 Inclusion of Costs of Using Natural Resources in Accounting System

The business has been consuming natural resources but it makes no provision for including

costs of using natural resources in their accounting system. When they project their profit or losses, they do not take the cost of using natural resources in consideration. Thus, the business corporations are tempted to misuse natural resources which may create a very serious problem for the entire humanity. The business corporations will have to seriously consider that how consumption of natural resources and their degradation by business institutions can be accounted. The governments, business organisations, and academic researchers will have to seriously consider the approach for incorporating changes in accounting systems to encourage sustainable development.

1.1.9 Unlimited Boundaries for Business Operation

"Globalisation is defined as a process that cuts across National boundaries, integrating and connecting communities in new space-time combinations." (Refer book: Hall S, Held D, McGrew T (1992), *Modernity and Its Futures*, The Open University and Polity Press, Cambridge).

"As information technology (IT) breaks down the barriers of time and location, distinctions are also breaking down between large and small companies. Small, agile firms are now effectively competing with industry giants because IT can make a consortium of small firms look, feel and get big, reaching out for customers once beyond their grasp. This has given rise to intense competition, blurring the boundaries between domestic and global markets". (Refer book: Luftman J. N. (1996), *Competing in the Information Age: Strategic Alignment in Practice*, Oxford University Press, Oxford.)

This means that for a similar type of product or service the number of players competing in the market has increased substantially. As a result the both the threats and opportunities for any organisation have increased manifolds.

Today, the business operation has become so complicated that each business corporation has to attempt in an organised manner for acquiring best possible resources (human and non-human) from suppliers located in different parts of the globe. Several resource suppliers located in different parts of the world are so much able that they can supply such resources (technology, operational style, managerial ability, machines and materials) to business corporations, which can significantly improve the level of performance and efficiency of the receivers of these resources. Therefore, it seems clear that the business world of today is no

longer limited by '*National boundaries*'. Every business corporation needs to have a global perspective if they want to survive and prosper effectively in highly volatile competitive business environment. Global business now appears to be a fact of life.

The present era of economic activities is represented by '*multi actor stage*'. It involves many participants in performing business activities. These participants belong to a variety of different interest groups. Each participant rightfully believes that the activities of multinational corporations affect them. Thus, those business corporations that are performing their business activities on the global scale should consider developing appropriate relationship with many groups. May be, the business corporation has no direct business considerations with these groups? The membership of these groups transcends national boundaries, special interest (racial, religious, ethnic) groups, international agencies and economic alliances among others. These groups have developed a certain degree of political power, and therefore the referred business corporations cannot afford to ignore them. In this regard, the business corporations should carefully note the influence exerted by environmental groups around the world. They have influenced business corporations to incorporate '*green*' or '*ecological*' issues into international strategic decisions. To be successful in such a business environment, business corporations need to regularly assess how such perspective may affect their activities.

1.1.10 The Social Responsibility

In the changed business scenario, transnational business corporations will have to properly dispose their social responsibility. The United Nations has given high priority to establishing an appropriate code of conduct for transnational corporations through the United Nations Commission on Transnational Corporations (UNCTC). The 1980s saw attempts within the UN system to secure effective international arrangements for the operation of translational corporations which are designed to promote the contribution of transnational corporations to national developmental goals and world economic growth while controlling and eliminating their negative effects. The multinational companies usually prefer to regulate themselves regarding social responsibility rather than being regulated by outside bodies. In their own interest, these corporations should keep outside regulation to a minimum.

1.2 RESEARCH & DEVELOPMENT: KEY TO BUSINESS SUCCESS & GENERATION OF WCM MODELS

The rapid innovations in information and other technological systems call for massive investment in activities related to Research and Development. It is expected that this will not only ensure the corporations to successfully survive in volatile competitive environment but also help them to march ahead and achieve their pre-determined goals. "Remember that in fast changing world, an allegiance to a single technology or to one particular business concept will stifle innovation and ultimately kill the company" (Refer book: Gary Hamel (2000) – *Leading the Revolution*, Harvard Business School Press, Boston, Massachusetts). Thus, it can be seen that current business environment has proved that traditional system of business operations and managerial styles are not appropriate now. This has also created a need for corporate leaders to extensively involve in research and investigate new ways to achieve manufacturing and managerial excellence and effectively implement them.

Brief Background of World Class Manufacturing

- During 1950s: the productivity of United States was 8 to 10 times that of Japan.
- Toyota Management aimed & focused on 10 fold productivity enhancement. After 1973, the Toyota Production System (TPS) became prominent.
- Western industries, in the mean time, kept on excelling on JIT or Manufacturing Resource Planning (MRP II), Automation (viz. Robotics), Information Technology (IT) including Enterprise Resource Planning (ERP) which added dimensions to present day's WCM

The beginning:

- In 1946 Mr. Shigeo Shingo noted that the real customer value is added to the material by Processing, Inspection, Transport & Storage and therefore fundamental improvement needs to distinguish between product flow (Process) and work flow (Operation) to be analyzed separately. This was well admitted in WCM.
- Dr. Genichi Taguchi introduced Robust Quality stressing on off line (pre-production) quality control as opposed to on line (production- stage) quality control.

The making of WCM Business Models:

- Dr. William Edwards Deming in 1950 visited Japan on invitation of Japanese Union of Science & Engineering (JUSE) followed by Mr. Joseph M. Juran in 1954 **and laid foundation of quality revolution in Japan.** *(Both were disciples of Walter A. Shewhart; the originator of control charts and cycle of Plan-Do- Study-Act (PDSA)*

- ***The Schonberger's Framework of WCM** (1986) is summarized as;*
  - The 'continual' and rapid 'improvement' in quality, cost, lead time, customer service and flexibility will lead to 'World Class' status.
  - The two parallel paths; Quality path and JIT production path are adapted. Three WCM precepts namely; JIT principle, Total Quality Control (TQC) and third Total Productive Maintenance (TPM) are included.

- ***The Gunn's Model of WCM** (1987) briefed as;*
  - Three Pillars approach; Computer Integrated Manufacturing (CIM), Total Quality Control (TQC) and Just-in- Time (JIT) production method.
  - Proposes Arthur Young's Manufacturing for Competitive Advantage frame work.
  - The Vision is based upon two references; 'Global Market' and 'Global Competitors'.
  - The next level in the frame work is interfacing with Integrated Manufacturing through five main distribution functions; Product & Process Design, Planning & Control, Production, Distribution, Services.

- ***The Maskell's Model of WCM** includes;*
  - A new approach to product quality.
  - JIT production techniques.
  - Work force Change Management.
  - Flexible approach to Customer requirement.

- ***The TQM Model developed by Prof. Gopal Kanji and Dr. Mykasa*** *is briefly outlined as;*

The Model has been conceived as a Pyramid with Business Excellence at the Appex

The Base of Pyramid is Leadership which has following four Principles:-

- Delight Customer
- Management by Fact
- People Based Management
- Continuous Improvement

Each for above four base Principles, there are following Eight Concepts (Two Concepts each) which constitute the Sides of Pyramid:-

- Customer Satisfaction
- Continuous Improvement Cycle
- All Work is Process
- People make Quality
- Internal Customers Are Real
- Team Work
- Prevention
- Measurement

- Dr. Noriaki Kano's Model for Customer Satisfaction & Delight has basically following Elements:-
  - Basic Needs
  - Performance Needs
  - Excitement Needs

There are Paired Questions for making survey of the Customer Satisfaction, Hummer and Delight of the Customers. This model has been elaborately explained in Chapter-3 under heading; 3.3.6 Customer Driven: Internal & External - (Dr. Noriaki Kano's view about Customer Requirement and Customer Delight)

CHAPTER – 2

THE PRESENT SCENARIO IN THE FIELD OF QUALITY AND MANUFACTURING

2.1 Introduction to Cost

Cost is a measure or symptom of the way of doing business. Cost is a cause of the way of doing business. Thus the way of doing business is recursive (and so is cost). Cost is also a measure in monetary units of the work of human endeavour. Cost has units of work. All real systems have an allocated cost which is a measure of the work of human endeavour required to conceptualise, evaluate, design, prototype, test, produce, deploy, operate, support, evolve, retire and manage the system.

Cost Quality improvement through concurrent engineering

Another key element is better design of the product for manufacturability. To do this, integrated design teams are formed, pulling together product design, engineering and manufacturing. The objective is to design a product for manufacturability as well as for other objectives. In some cases, packing and distribution, marketing and R&D functions are also brought into the concurrent engineering process." (Refer book: Dean, J.W., Sussman G.I. (January-February (1989), *"Organizing for Manufacturable Design"*, *Harvard Business Review*.)

Activity Based Costing

All the above discussion leads to a kind of a Costing Technique known as "Activity Based Costing". (Refer book: Cokins Gary (2002), *Activity-Based Cost Management Making It Work: A Manager's Guide to Implementing and Sustaining an Effective ABC System.)* An activity is an organisational implementation of a function. A function is associated with purpose. Thus, activity based cost measures the amount of the work of human endeavour consumed in accomplishing a specific activity. Accountants use the average cost per activity times the number of times an activity is performed within a process to cost an activity within a process. As activity based costing measures the processes and since processes define operations, activity based costing is the natural way to measure and estimate operations cost.

Accountants assume that the cost per activity is a constant. In reality, the cost of a process is probabilistic in nature because of the variations, which occur within the process. Thus the cost each time is a realization from the cost distribution of that process. This calls for the application of all Statistical Techniques to control cost and to look for and fix special and common causes of variation. According to Taguchi's Loss Function theory, reducing this variation will reduce the cost to society.

Taguchi's Loss Function

It states that a parabolic representation that estimates the quality loss, expressed monetarily, that results when quality characteristics deviate from the target values. The cost of this deviation increases quadratic ally as the characteristic moves away from the target value.

Graphically, the loss function is represented as follows:

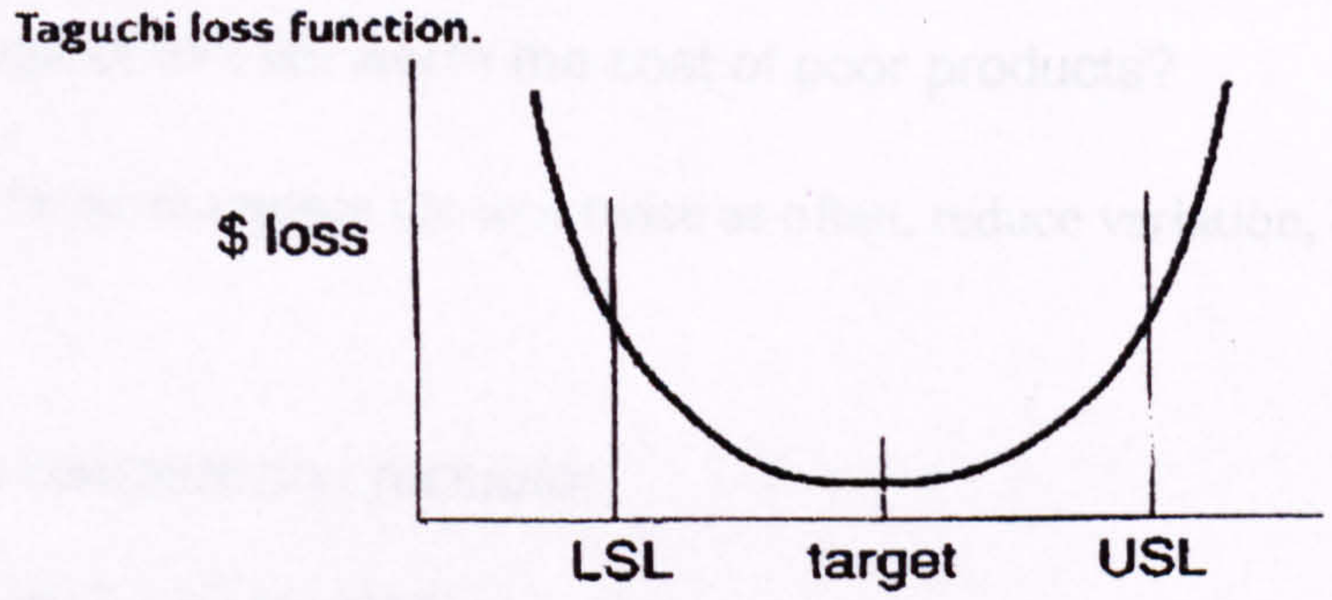


Fig 2.1 – Graphical representation of Taguchi's Loss Function

This standard representation of the loss function demonstrates a few of the key attributes of loss. For example; the target value and the bottom of the parabolic function intersect, imply that as parts are produced at the nominal value, little or no loss occurs. Also, the curve flattens, as it approaches and departs from the target value. (This shows that as products approach the nominal value, the loss incurred is less, than when it departs from the target.) Any departure from the nominal value results in a loss.

Loss can be measured per part. Measuring loss encourages a focus on achieving less variation. As we understand how even a little variation from the nominal results in a loss, the tendency would be to try and keep product and process as close to the nominal value as possible. This is the specific benefit about the Taguchi's loss function. It always keeps our focus on the need to continually improve.

A company that manufactures parts requiring a large amount of machining, grew tired of the high costs of tooling. To avoid premature replacement of these expensive tools, the manager suggested that operators should set the machine to run at the '*high end*' of the specification limits. As the tool would wear down, the products would end up measuring on the low-end of the specification limits. Thus, the machine would start producing parts on the *'high-end'* and after a period of time, the machine would produce parts which will be falling just inside of the specifications. The variation of parts produced on this machine was much greater than it should be, since the strategy was to use the entire *specification-width* allowed rather than produce the highest quality part possible. Products may fall within specification, but will not produce close to the nominal. Several of these 'good parts' may not assemble well, may require recall, or may come back under warranty. The Taguchi loss would be very high.

We should consider following vital questions:-

- Is the savings of tool life worth the cost of poor products?

- Would it be better to replace the tool twice as often, reduce variation, or look at incoming part quality?

Taguchi Loss computation formula:-

Loss at a point: $Lx = k*(x-t)^2$ --- --- --- --- --- --- --- --- (i)

where,

k = loss coefficient

x = measured value

t = target value

Average Loss of a sample set: $L_{avg} = k*(s^2 + (pm - t)^2)$ --- --- --- -- (ii)

where,

s = standard deviation of sample

pm = process mean

Total Loss = Avg. Loss * number of samples --- --- --- --- --- (iii)

Example: A medical company produces a part that has a hole measuring 0.5" +_ 0.050". The tooling used to make the hole is worn and needs replacing, but management doesn't feel it necessary since it still makes "good parts". All parts pass QC, but several parts have been

rejected by assembly. Failure costs per part is $0.45. Using the loss function, explain why it may be to the benefit of the company and customer to replace or sharpen the tool more frequently. Use the data (measured values) below:

0.459 | 0.478 | 0.495 | 0.501 | 0.511 | 0.527	0.474 | 0.491 | 0.498 | 0.505 | 0.524 | 0.533
0.476 | 0.492 | 0.500 | 0.509 | 0.527 | 0.536	0.462 | 0.483 | 0.495 | 0.501 | 0.516 | 0.532
0.467 | 0.489 | 0.495 | 0.502 | 0.521 | 0.532	

The average of the points is 0.501 and the standard deviation is about 0.022.

finding k:-

using formula - (i)

$0.45 = k * (0.505 - 0.500)^2

k = 18000

finding average loss:-

using formula - (ii)

$L_{avg.} = 18000 * (.022^2 + (.501 - .500)^2) = 8.73$

Thus the average loss per part in this set is $8.73 (or £ 5.82)

For the loss of the total 30 parts produced:-

Using formula - (iii)

Total loss = $8.73 * 30 = $261.90 (or £174.60)

From the calculations above, one can determine that at 0.500", no loss is experienced. At a measured value of 0.501", the loss is $0.018, and with a value of 0.536", the loss would be as much as $23.00. Even though all measurements were within specification limits and the average hole size was 0.501", the Taguchi loss shows that the company lost about $261.90 per 30 parts being made. If the batch size was increased to 1000 parts, then the loss would be $8730 per batch. Due to variation being caused by the old tooling, the department is losing a significant amount of money.

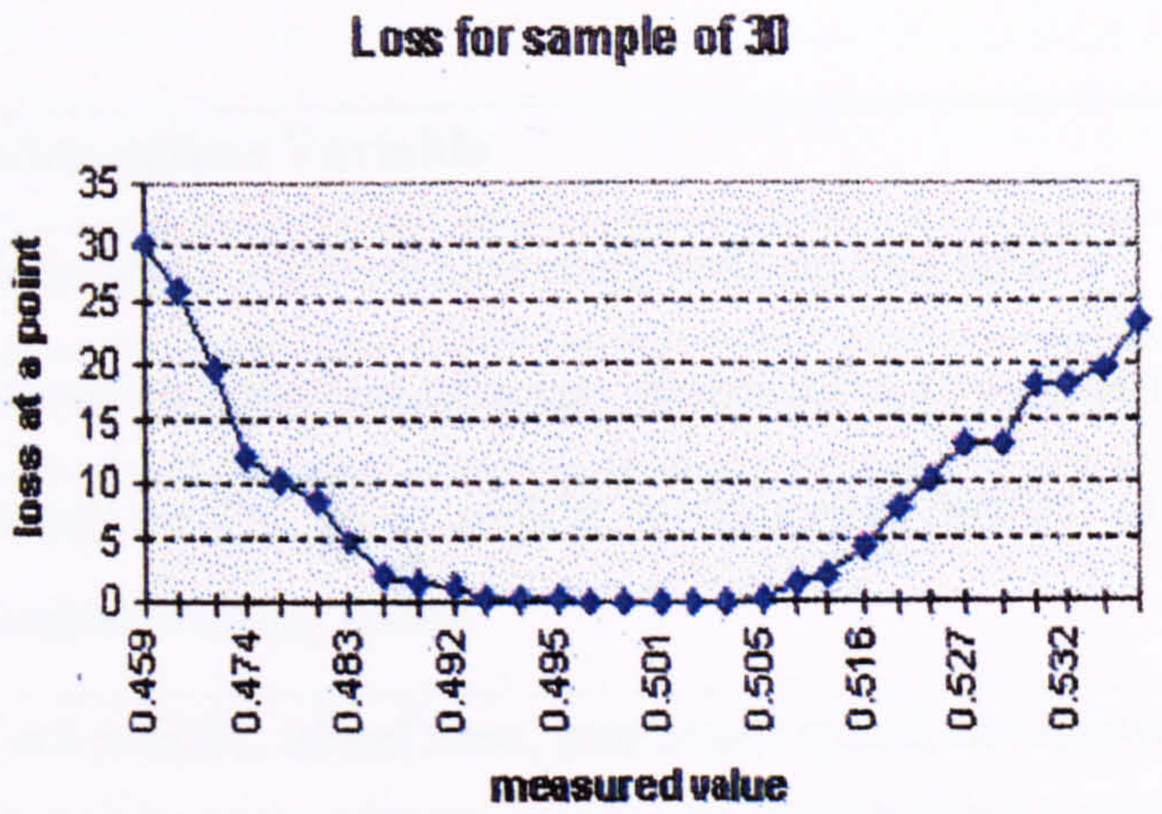


Fig 2.2 – Example of Taguchi's Loss Function

If we were to graph the loss it would look like this:

From the above chart, we can see that deviation from the nominal could cost as much as $0.30 per part. In addition we would want to investigate whether this kind of deviation would compromise the integrity of the final product after assembly to the point of product failure.

If parametric cost estimation is put together with activity based costing the resultant would be activity based costing. This would express the average cost per activity in terms of process quality characteristics. Given such equations, one could then determine very clearly what must be done to reduce the cost.

Definition: A technique employing one or more CERs and associated mathematical relationships and logic. The technique is used to measure and/or estimate the cost associated with the development, manufacture, or modification of a specified end item. The measurement is based on the technical, physical, or other end item characteristics.

This definition establishes the clear linkage between cost and a product's (or of end item) technical parameters. Without this linkage, a product cost cannot be effectively defined. Non-parametric estimating systems generally do not connect technical (parametric) and cost elements with any substantial precision.

A Parametric Cost Model is defined as: a group of cost estimating relationships used together to estimate entire cost proposals or significant portions thereof. These models are often computerised and may include many inter-related CERs, both cost-to-cost and cost-to-non-cost. Parametric techniques focus on the cost drivers, not the miscellaneous details. The drivers are the controllable system design or planning characteristics and have a predominant effect on system cost. Parametric uses the few important parameters that have the most significant cost impact on the product(s), hardware or software, being estimated.

Product	Independent Variable
Construction	Floor space, roof surface area, wall surface area
Gears	Net weight, percent of scrap, inches of teeth cut, harness, envelope
Trucks	Empty weight, gross weight, horsepower, number of driving axles, loaded cruising speed
Passenger car	Curb weight, wheel base, passenger space, horsepower
Turbine engine	Dry weight, maximum thrust, cruise thrust, specific fuel consumption, by-pass ratio, inlet temperature
Reciprocating engine	Dry weight, piston displacement, compression ratio, horsepower
Sheet metal	Net weight, percent of scrap, number of holes drilled, number of rivets placed, inches of welding, volume of envelope
Aircraft	Empty weight, speed, useful load, wing area, power, landing speed
Diesel locomotive	Horsepower, weight, cruising speed, maximum load on standard grade at standard speed

Table 2.1 - CER Types

2.2 Contemporary Quality Initiatives/Systems/Techniques and Procedures

Some of the Quality and Manufacturing Processes improvement programs which are in progress or have been initiated in Organisations all across the Globe are ***Activity Based Costing, Value Engineering, Business Process Re-engineering, Total Productive Maintenance, Just–in–time Methodology, Autonomation, Total Quality Management, Multi-process Cost Management, Benchmarking, Toyota Production System, Risk Management, ISO Systems and Procedures, International Quality Rating System, Six Sigma Smarter Solutions and Theory of Constraints.***

2.2.1 Value Engineering

Value engineering is a process. It is formed on the concept of function analysis. Value Engineering operates on the functions of the product. By use of *Value Engineering* one can

expand the design space so that the least costly alternative can be chosen.

Function Analysis is an integral part of *Value Engineering* and is used here as the process of analysing the functional, rather than the physical characteristics of a system. A function may be stated in the form {verb, noun}. It is an action upon something: eat food, go to work, and cash pay checks are very important functions in the life for most of the people.

Function analysis is also a primary tool for another tool known as *Quality Function Deployment.*

The aim of function analysis is to reveal each of these actions and thus identify the nature of the products and services to which they belong. Their creators with certain purposes endow all products and services. Function analysis reveals the intentions or purposes behind the creation of a product or service and thereby identifies the nature of that product or service. Although products and services exist as physical objects or systems, they are not created out of nothing. They are preceded by an idea/concept which is the basis of their creation. Function analysis identifies the nature of products and services by revealing these concepts.

Having determined the nature of an object, one can then conceptualise many physical realisations, which serve the purpose and choose the realisation with the best value. In this manner breakthroughs are designed.

Value Engineering is essentially a process, which uses *Function Cost Analysis* to reduce cost. Founded by Miles (1961), it has a proud history of success of more than 40 years at reducing cost. (Refer book: Cook, T. F. (1984).*"Welcome to Value Analysis and Value Engineering,"* Proceedings of the Society of American Value Engineers, Vol.19) But times and needs have changed. *Value Engineering* usually comes into play after the design is finished, though the thoroughness sought in design can be achieved only when decisions are made early.

The definition of *Value* as used by value engineers in America is different from the definition in design for competitive advantage. In *Value Engineering* practice, the *Value* is largely equated with reduced cost where as in design for competitive advantage, value is defined as the measure of customer choice. *Value* is a function of quality, as well as cost. "Value Engineering should be a natural part of any design project. However, the strong focus on cost reduction disqualifies value engineering as a general method for evaluating quality." (Refer book: Morup, M. (1992).- *A New Design for Quality Paradigm,* Journal of Engineering Design, Vol. 3, No.1.)

Since value is a function of quality, this implies that value engineering, as practiced, must be disqualified as a general method for evaluating value.

As practiced today, *Value Engineering* largely ignores the fact that customer choice is usually based upon far more than minimum essential product function. There is an interesting note based upon the work of Meyer (1971) reading as "an Important transformation which is very similar to those in QFD (Quality Function Deployment)." (Refer book: De Marle, D. J. (1971). *"Criteria Analysis of Consumer Products,"* Proceedings of the Society of American Value Engineers, Vol. 6)

It is also interesting that it was published around the same time frame when "Dr. Akao added the analogous transformations to QFD".(Refer book: Akao, Y. (1994). Personal notes from the First North American QFD Master Class)

Evidences are increasing that *Value Engineering* has strong influences on or is parallel with the development of QFD. Evidence also indicates that *Value Engineering* and QFD have followed similar growth paths, the difference being that QFD has developed far more comprehensively and rapidly.

2.2.2 Business Process Re-engineering (BPR)

Like value engineering BPR is also a Process. It is also formed on the concept of a function. It operates upon the system's functions.

In BPR the current process is mapped with the ideal state of the process. All the non – value adding activities are removed and if the need be the new state may be enabled and made more efficient through use of Information Technology. "Information age organisations operate with integrated business processes that cut across traditional business functions (Hammer and Champy 1993)." (Refer book: Hammer, M and Champy, J. (1993), *Reengineering the Corporation: A Manifesto for Business Revolution*, Nicholas Brealy Publishing, London.)

2.2.3 Total Productive Maintenance

When a process is highly automated, two of the largest cost drivers are machine ineffectiveness and line downtime. They are inter-related. A system of maintenance known as **Total Productive Maintenance** greatly increases machine effectiveness and line throughput as well. If the operators maintain the machines, large cost savings are realized. In production environment, the criterion where quality comes first is met by ***Total Productive Maintenance.***

2.2.4 Multi Process Cost Management

The most powerful way of reducing cost is doing *Multi Process Cost Management* because it

implements a combination of many ways to reduce cost. Implementation of Kaizen under Total Quality Control (as a part of Total Quality Management), followed by Total Productive Maintenance, Just in time, Autonomation and Task Interleaving. The order of implementation is important because each process enables the process to follow. Kaizen implements the desire to improve. Total quality control implements a structure to enable and control improvement by maximizing human effectiveness and reducing waste. Platt of Hewlett-Packard, among many others, notes that the "cost savings due to quality can be very large" (Refer book: Anon. (1994). *"After All Tests Have Been Graded, Will TQM Get an A+ or an F?"* Management Review, January.). Incidentally, Toyota uses value engineering within its design process to reduce cost and considerably reengineered its whole business process to arrive at the current state. Each of these processes is an element of the Toyota cost management strategy.

2.2.5 The Toyota Production System (TPS)

The Toyota Production System is a manufacturing process model developed by Toyota that led to their dominance in the auto industry. This production approach enabled Toyota as well as many other companies to achieve major improvements in productivity and quality.

The Toyota Production System was built on three following key factors that differentiated it from practices being employed by their competitors in the auto industry :-

1) Reduced lot sizes, leading to production flexibility.
2) Controlling parts required in production to enable them to be provided when and where they are needed for specific tasks.
3) Arranging production equipment in the order that is easy for people to work and not just grouping them by equipment function.

This system has been so successful that its methods are frequently imitated, and the approach has been applied in the areas of Product Development, Service Delivery, and Business Management Systems.

After Second World War, Eiji Toyoda and Taiichi Ohno at the Toyota motor company in Japan pioneered the concept of Toyota Production System. The rise of Japan to its current economic pre-eminence quickly followed, as other companies and industries copied this remarkable system. Manufacturers around the world have embraced this innovative system. The companies that first mastered this system were all head-quartered in one country - Japan. However, many Western companies now understand Toyota Production System.

Basic idea and Framework of Toyota Production System

The Toyota Production System has been developed by steadily pursuing the orthodox way of production management. With the realisation of this concept, unnecessary intermediate and finished product inventories would be eliminated. However, although cost reduction is the system's most important goal, it must achieve three other sub-goals in order to achieve its primary objective. They include:-

- Quantity control, which enables the system to adapt to daily and monthly fluctuations in demand in terms of quantities and variety;
- Quality assurance, which assures that each process will supply only good units to the subsequent processes;
- Respect-for-humanity, which must be cultivated while the system utilises the human resource to attain its cost objectives.

Achieving two key concepts creates a continuous flow of production, or adapting to demand changes in quantities and variety, *JIT* and *Autonomation*. These two concepts are the pillars of the Toyota production system.

JIT basically means to produce the necessary units in the necessary quantities at the necessary time. Autonomation ('*Jidoka*' in Japanese) may be loosely interpreted as autonomous defects control. It supports JIT by never allowing defective units from the previous process to flow into and disrupt the subsequent process. Two concepts which are also key to the Toyota production system include Flexible Work Force ('*Shojinka*' in Japanese) which means varying the number of workers to demand changes, and creative thinking or inventive ideas ('*Soikufu*' in Japanese) or *capitalising* on workers suggestions.

To realise these four concepts, Toyota has established the following systems and methods:

- Kanban system to maintain JIT production
- Production Smoothing method to adapt to demand changes
- Shortening of Set-up time for reducing the production lead time
- Standardisation of Operations to attain line balancing
- Machine Layout and the multi-function worker for flexible work force
- Improvement Activities by small groups and the suggestion system to reduce the work force and increase the worker's morale.

- Visual Control system to achieve the Autonomation concept
- Functional Management system to promote *company-wide quality control.*

A common strategy used by firms for achieving the goal of Global Competitiveness is to significantly tighten all aspects of the manufacturing process, which includes co-ordination strategy, such as "JIT (Refer book: Ohno, Taiichi (1992), *Toyota Production System: Beyond Large-Scale Production*, Productivity Press, Madras.) and overall quality-improvement programs JIT is a means of market pull inventory management embedded within a humanistic environment of improving continuously. Use of Just-in-Time methods results in considerably reduced inventory and enhanced customer response

Autonomation is the concept of reducing serial process waste by not allowing bad product to enter the process. This is accomplished by 100% online product quality inspection after each sub process with least human involvement minimising the chances of committing error to zero. *Task Interleaving* permits the same serial process to produce many different products in arbitrary sequences.

Kanban system: is the way to manage the JIT production method. In short, the Kanban system is an information system to harmoniously control the production quantities in every process. In this system what kind of units and how many units needed are written on a tag-like card called Kanban. The Kanban is sent to the people of the previous process from the subsequent process. As a result, many processes in a plant are connected with each other. This interlinking of processes in a factory allows for better control of necessary quantities for various products.

Kanban system works well in following cases:-

- Smoothing of production
- Reduction of set-up time design of machine layout
- Standardisation of jobs
- Improvement activities
- Autonomation

A Kanban is usually a card put in a rectangular vinyl envelope. Two kinds are mainly used: Withdrawal Kanban and Production-ordering Kanban. A Withdrawal Kanban details the kind and quantity of product which the subsequent process should withdraw from the preceding process, while a Production-ordering Kanban specifies the kind and quantity of the product which the preceding process must produce.

2.2.6 Total Quality Management (TQM)

Since TQM was presented as one of the theories that lead to competitive advantage, it is necessary to further investigate the validity of such a proposal.

Firstly, it is not a panacea for all problems in organisations which fits in all types of organisations, and secondly, it is not the only way to give organisations a competitive advantage. The main philosophy of "TQM" (Refer book: Kaoru Ishikawa (1991), *Guide to Quality Control*, Asian Productivity Organisation.) is prevention rather than eliminating problems after they happen. Total Quality Management is a way of doing business by creating an environment which responds quickly to the changing requirements of the clients. In TQM, all members of an organisation need to understand their value and role, both as customers and as suppliers to every customer/supplier with whom they interact, inside and outside the organisation. Since TQM focuses on improving the process, output from these processes usually meet or exceed a client's expectations. This differs from quality control, which depends on inspecting for mistakes and defects at the end of the process rather than building quality into the process during design and implementation. Thus, TQM is process-focused rather than outcome-focused

The application of TQM concepts to service industries is resulting in new concepts based on Kotler's marketing approach and a strong customer focus. Deming, Juran, and Crosby, who initiated the TQM process, share a common theme of participatory management. Management participation and attitude, professional quality management, employee participation, and recognition reflect a philosophy making internal and external customer satisfaction as the organisation's primary goal.

Senge quoted in Gibson (Eds. -1997) mentions three major driving forces in organisations. These are the great advancement in technology, globalisation, and the increasing complexity and interdependence. These already have dramatic impact on the way we live as we approach the 21st Century. For paradigms to have lasting effect, they have to address these forces. A major paradigm in the last quarter of the 20th century has been the impact of TQM on organisations.

The development of TQM can be traced to several consultants including Deming, Juran and Crosby. TQM is a process and strategy that in certain situations can improve an organisation's effectiveness and efficiency. TQM places responsibility for quality problems with management rather than on the workers. A principal concept of TQM is the management of process variation, which seeks to identify special and common needs.

The objective of TQM is the continual improvement of processes, achieved through a shift in focus from outcomes (or products) to the processes that produce them. TQM is a management

approach to long-term success through customer satisfaction. TQM is based on the participation of all members of an organisation in improving processes, products, services, and the culture they work in. The methods for implementing this approach are found in the teachings of such quality leaders as Philip B. Crosby, W. Edwards Deming, Armand V. Feigenbaum, Kaoru Ishikawa, and J. M. Juran. TQM is a holistic approach to managing complex organisations and replaces top-down management with decentralised customer-driven decision making.

A widely known element of TQM is Deming's Plan-Do-Study-Act (PDSA) problem-solving cycle, which has become the cornerstone of the TQM movement.

The following Steps depict the PDSA model:

1. Establish new procedures and policies
2. Standardise change
3. Manage change
4. Measure and verify performance
5. Validate benefit
6. Select process
7. Create purpose statement
8. Define the process
9. Gather data
10. Chart data
11. Analyse data
12. Develop and approve plan
13. Implement pilot program

Whereas SPC (Statistical Process Control) is a precise set of quality improvement techniques, TQM extends quality improvement methods to all functions and all management levels

2.2.6.(a) Total Quality Control

In 1950's, the Japanese began to learn and apply the statistical quality control tools following the thoughts of Walter A. Shewhart, Dr. William Edwards Deming and later on Mr. Joseph Juran. Their progress in continuous improvement led to the expansion of the use of TQC. Kaoru Ishikawa, head of the Japanese Union of Scientists and Engineers (JUSE) expanded the use of these approaches in Japanese manufacturing in the 1960's with the introduction of the **7 Quality Control (7QC) tools.**

The Seven QC Tools:

1) The **Cause and Effect Diagram** is also called the 'fishbone diagram' because of its appearance and the 'Ishikawa diagram' after the man who popularized its use in Japan. Its most frequent use is to list the cause of particular effect of problems. The lines coming off the core horizontal line are the main causes and the lines coming off those are sub causes.

The CE Diagram leads to immediate identification of major causes and point to the potential remedial actions. It also indicates the best potential areas for further exploration and analysis. Preparation of a CE Diagram leads to greater understanding of the problem.

A good CE diagram is one which explores all possibilities so it is likely to be large and complex-looking like a twig after twig sprouts, for each new related idea is noted down. One needs to be suspicious of CE Diagrams with few factors, or which are neat and well ordered. These may reflect a lack of knowledge of the situation, or show that the effort to draw the diagram was not creative and exhaustive enough.

2) The **Scatter Diagram** shows the pattern of relationship between two variables that are thought to be related. For example; is there a relationship between out side temperature and cases of the common cold? As temperature drop, does cold increase? The closer the points hugging a single line, the higher is their relationship direct or inverse.

3) The **Pareto Chart** shows the distribution of items and arranges them from the most frequent to the least frequent with the final bar being miscellaneous. The tool is named after Pareto, the Italian economist who determined that wealth is not evenly distributed. Few of the people have most of the money. This tool is a graphical picture of the most frequent causes of a particular problem. It shows where to put the initial effort to get the most gain.

4) The **Histogram** is a bar chart showing a distribution of variables. An example would be to line up by height a group of people in a course. Normally one would be the tallest and one would be the shortest and there would be a cluster of people around an average height. Hence the phrase "normal distribution". This tool helps identify the cause of problems in a process by the shape of the distribution as well as the width of the distribution.

5) The **Control Chart** is a line chart with control limits. It is based on the work of Shewhart and Deming. By mathematically constructing control limits it is determined what variation is due to normal ongoing causes (common causes) and what variation is produced by unique events (special causes). It is easier to improve quality by first eliminating the special causes and then reducing common causes.

6) The **Check Sheet** is a data-gathering and interpretation tool.

A Check Sheet is used for:

- Distinguishing between fact and opinion (example: how does the community perceive the effectiveness of the school in preparing students for the world of work?)
- Gathering data about how often a problem is occurring (example: how often are students missing classes?)
- Gathering data about the type of problem occurring (example: What is the most common type of word processing error created by the students-grammar, punctuation, transposing letters, etc.?)

7) The Graphs give pattern of variation. These are of many pattern and sizes and are used to record the result and to find out trend of variation.

*In the early 1970's as Total Quality Control expanded to service and administrative areas, it became clear that the 7QC tools (which mostly are data based) were not always appropriate, so **Seven New Quality Control Tools** were developed under the leadership of Nyatanni.* These tools are particularly helpful in improving planning and generally do not require elaborate records and data.

The New Seven QC Tools:

1) The **Affinity Diagram** is a tool for organising language data. After ideas are brainstormed and written on cards, they are grouped together with similar ideas. A header card is created which captures the meaning of each group of ideas. This is a creative, right brain, activity.

2) The **Interrelationship Diagram** shows the relationships between items by drawing an arrow from one idea that causes another idea to an idea that is the result. Sometimes the arrow is drawn from one action that occurs before another action. The items that have mostly arrows going in are long range targets and the items that most arrows going out are initial action items

3) The **Tree Diagram** takes a purpose and logically breaks it into action items. As you read from left to right it goes in a logical progression from general to specific. If you read the chart from left to right, it answers the question "how accomplished?" If you read it from right to left, it answers the question why?

4) The **Matrix Diagram** shows the relationship between two or more sets of items. It can be very useful in facilitating an analysis of the relationship of each item in one set to all items in the other set. This often triggers some thinking that would not have happened if this organised approach was not used. It is also helpful to see patterns of relationships. Which

items don't relate to anything and which ones are heavy hitters.

5) The **Prioritisation Matrix** enables the selection of priority items by applying a set of criteria to each item. Sometimes the list of criteria is fairly simple. Other times it is weighted with a great deal of precision (e.g. the Analytical Hierarchy Process-AHP).

6) The **Process Decision Program Chart** (PDPC) is a tool for contingency planning. It begins by listing the steps in a particular activity. It then lists what could go wrong at each step and finally it lists the counter measures for things that can go wrong. Sometimes it is drawn in the flow chart format below. Other times it is arranged as a numericai tree diagram.

7) The **Activity Network Diagram** is a simplified version of PERT (Program Evaluation and Review Technique). It is a method for mapping out the sequence in which activities will be undertaken. One of its benefits is that it indicates which items can be done simultaneously. Another benefit is that it makes it clear what set of activities will take the longest and where time efficiencies can be achieved.

2.2.7 Benchmarking

Benchmarking is a tool, which helps to improve the business processes. Any business process can be benchmarked. It is the process of identifying, understanding, and adapting outstanding practices from organisations anywhere in the world to help your organisation improve its performance. It is an activity that looks outward to find best practice and high performance and then measures actual business operations against those goals. One of the biggest mistakes people make when beginning their benchmarking endeavor is that they only look to benchmark someone within their own industry. Worse yet, some people think they must benchmark their competitor. What if the competition is worse than your company? Seems like a pretty good waste of time end energy.

It is a good idea to benchmark a company that is well known for being a good model?

Ask certain clarification as;

- Is the Bottom Line, who does the business process real well and has processes that are adaptable to your organization?
- Who is the most compatible for me to benchmark?
- Do I need to conduct a full on benchmark study or can I get 80-90% of what I need from just using the telephone, email, or an electronic survey? All these questions need to get addressed

Most business processes are common throughout industry. For example; NASA has the same fundamental *Human Resources* requirements for hiring and developing employees, as does American Express. British Telecom has the same *Customer Satisfaction Survey* process as Brooklyn Union Gas. These processes, albeit from different industries, are all -common and can be benchmarked very effectively. It is called '*getting out of the box*'.

Benchmarking is one of the new vogue subjects, along with a raft of quality related initiatives. What can be so difficult about examining how other organisations have achieved improved performance? The answer is nothing, but examining others is a world away from really learning how they achieved the improvement.

Many organisations publicise what they have achieved, but it is unusual for them to be lucid on the more mundane facts of how this transformation was made to work. Benchmarking is one of the most effective means to identify improvements, which can make a significant difference to an organisation.

Each year, The Benchmarking Exchange (TBE) reports on the most actively benchmarked business processes. The information is collected from thousands of TBE members and ranked by the most benchmarked process for the most recent twelve months. The purpose of the annual ranking is to show what business processes are being focused on the most and to provide a bit of insight as to what to expect in the coming year. TBE was created in 1991 in response for a need for organizations to effectively share and learn from each other's experiences in business management. TBE is participated by thousands of subscribers from some of the world's leading quality associations, government agencies, and small to large size corporations from over 100 countries. The top-10 Business Processes shown are among hundreds of business processes tracked in TBE's Posting Board (sm) database.

TOP-10 Benchmarking Organizations

A new addition to this report is the Top-10 Benchmarking Organisations. This is a ranking of organisations that are heavily engaged in benchmarking. These member companies have implemented internal benchmarking methodologies to support their entire organisations' efforts to improve their products and services for both internal and external Customers. These organisations live and breathe improvement.

Business Process	Ranking
Customer Service / Satisfaction	1
Information Systems / Technology	2
Employee Development / Training	3
Process Improvement / Management	4
Call Centers / Help Desks	5
Performance Measurement / Improvement	6
Employee Recruiting / Staffing	7
Manufacturing / Assembly	8
Human Resources	9
Project Management	10

Table 2.2 – The top ten Business Processes

Organization	Ranking
Bank of America	1
American Express	2
U. S. Army	3
Xerox	4
TRW	5
Eastman Kodak	6
U.S. Department of Veterans Affairs	7
Ford Motor Company	8
U. S. Internal Revenue Service	9
Saudi Aramco	10

Table 2.3 – The top ten Benchmarked Companies

2.2.8 International Organization for Standardization – Systems and Procedures (ISO)

ISO is the International Organisation for Standardisation. It is made up of national standards institutes from countries large and small, industrialised and developing, in all regions of the world. ISO develops voluntary technical standards, which add value to all types of business operations. They contribute to making the development, manufacturing and supply of products and services more efficient, safer and cleaner. They make trade between countries easier and fairer. ISO standards also serve to safeguard consumers, and users in general, of products and services – as well as to make their lives simpler. ISO develops only those standards for which there is a market requirement. Experts on loan from the industrial, technical and business sectors which have asked for the standards, and which subsequently put them to use carry out this work. Others may join these experts with relevant knowledge, such as representatives of government agencies, consumer organisations, academia and testing laboratories. Published under the designation of International Standards, ISO standards represent an international consensus on the state of the art in the technology concerned. The vast majority of ISO standards are highly specific to a particular product, material or process. However, both ISO 9000 and ISO 14000 are known as generic management system standards. Generic means that the same standards can be applied to any organisation, large or small, whatever its product – independent of whether its product is actually a service in any sector of activity, and whether it is a business enterprise, a public administration, or a government department.

ISO 9000 is primarily concerned with quality management. The definition of quality in ISO 9000 refers to all those features of a product or a service, which are required by the customer. Quality management means what the organization does to ensure that its products conform to the customer's requirements. ISO 14000 is primarily concerned with environmental management. This means what the organization does to eliminate harmful effects on the environment caused by its activities. ISO 9000 is not a product 'quality label' or guarantee. ISO 14000 is not a 'green label' for products. ISO does not assess or audit quality or environmental management systems. When an organization has a management system certified to an ISO 9000 or ISO 14000 standard, this means that an independent auditor has checked that the process influencing quality (ISO 9000). or the process influencing the impact of the organization's activities on the environment (ISO 14000), conforms to the relevant standard's requirements. ISO/TC 176 and ISO/TC 207 are the ISO technical committees responsible for developing and maintaining the ISO 9000 and ISO 14000 families of standards respectively.

ISO International Organization for Standardisation does not itself issue certificates of conformity to ISO 9000 or ISO 14000. This is carried out independently of ISO by certification bodies in different countries. Therefore, there is no "official" central database of ISO 9000 and ISO 14000 certificates.

2.2.9 The International Quality Rating System™ (IQRS®)

This uses an objective audit-based protocol to measure and assess quality performance across eighteen critical functional areas. The **IQRS®** enhances the effectiveness of all quality management systems because it is comprehensive, flexible and objective. Regardless of whether you are concerned about ISO 9000, QS 9000, Malcolm Baldridge National Quality Award, or the European Quality Award, IQRS® ensures your quality management practices are examined thoroughly, measured accurately, and assessed objectively. **IQRS®** identifies management system redundancies and inefficiencies and pinpoints where improvements are needed. Audit results provide a solid foundation for developing relevant remedial action plans. It is used as a blueprint for implementation or to improve or expand existing programs, the **IQRS®** saves time, staff and resources.

2.2.10 Theory of Constraints (TOC)

The Theory of Constraints is the integration of the practical results of Eli Goldratt's work on "how to think". It is the thinking processes and their applications. TOC is a verifiable philosophy. By knowing how to think, one can better understand the world in totality; by better understanding one can improve.

Central to the concept of TOC is the acknowledgement of cause and effect. The thinking processes of TOC give us a series of steps, which combine cause-effect and our experience and intuition to gain knowledge; starting with observation of the world around us.

One extraordinary benefit of the thinking processes is that they provide the ability to recognise the paradigm shifts, which occur when times change but the assumptions and rules do not. One cannot constantly monitor every assumption to be sure that everyone is in line with constantly evolving reality, therefore, the ability to spot the shifts can be a real advantage. Those who continue their patterns of operation, regardless of the changing reality, will suffer when the effects of their actions are not those that they expect. Eli Goldratt's novel "The Goal" completely exposed the magnitude to which this problem can exist.

® Stands for registered, ™ Stands for Trade Mark

The Theory of Constraints (TOC) consists of three parts:

1) A set of problem-solving tools - called the TOC thinking processes (TP) - to logically and systematically answer the three questions essential to any process of on-going improvement: "What to change?", "To what to change to?" and "How to cause the change?"
2) A set of daily management tools - taken from the TOC thinking processes - that can be used to significantly improve vital management skills, such as communication, effecting change, team building and empowerment; and,
3) Innovative, proven solutions created by applying the TOC thinking processes to specific application areas, such as Production (as introduced in The Goal), Distribution (as discussed in Its Not Luck), Marketing and Sales (as discussed in Its Not Luck), Project Management, and setting the Direction of The Company, to name only a few.

Applying Theory of Constraints thinking requires a major paradigm shift from the traditional management focus of ***cost control*** to that of eliminating barriers to ***Throughput***, which is defined as the rate at which an entity produces money, through sales.

2.2.11 The Relationship Between TQM, TOC, and JIT (or MRP)

Each of the three major management movements of the eighties and nineties, *Just in Time (JIT)*, *Total Quality Management (TQM)*, and *Theory of Constraints (TOC)* claim to be ***THE*** answer to solving existing management problems. The three are really different facets of the same management philosophy.

Let us examine how TQM, TOC, and JIT are related. The foundation of modern total quality management is W. Edwards Deming. In his book, *Out of the Crisis*, Deming demonstrates that a TQM management philosophy is really the use of the concept of a system, systems thinking, process measurement and a never ending cycle of process improvement. TOC is really a focused methodology for performing systems thinking (using the concept of *Throughput* rather than *Cost Control*) on the business entity as a whole to focus changes to be made on constraints that are directly limiting better total-system profitability. JIT (or MRP) with its emphasis on inventory reduction and resource scheduling is really just a specific application of TOC to one area of the business. Thus, JIT and MRP are subsets (or consequences) of TOC that is a subset of TQM.

Measuring Business Performance:

The performance of a company is most frequently judged by examining its financial statements. The '*bottom line*' of a company is really a pair of numbers, not just one. The first number is an absolute measurement-such as Net Profit, which is reported on the Profit & Loss statement of a

company. The second number is a ratio-such as Return on Investment (ROI), the data for which is found on the Balance Sheet of a company. The third financial statement, Statement of Cash Position, is not a measurement of financial performance, but assists in assessing whether a company has sufficient financial maneuvering room to accomplish its goals.

The goal is to find a global performance measure that we can use locally to assist in decision making. None of the traditional measures-Net Profit, traditional ROI, or cash will do this. What is needed for local decision making is a method of measuring the rate at which a company produces money through sales. As we have seen before, Goldratt defines this as *Throughput.*

Given Goldratt's special treatment of labour costs, inventory, and operating expense, his definition of Return on Investment is:

Return on Investment (ROI) = (Throughput - Operating Expense)/Inventory

Thus, local decisions that increase company's throughput, decrease a company's operating expense, or reduce a company's inventory are most generally good decisions for the company.

Types of Constraints that Exist

Demand Constraints:

A demand constraint is a constraint on output. Symptoms include large amounts of final product inventory, or a production line running at a fraction of full capacity production which means; you have excess capacity given the demand for your product. You either have a problem with marketing (your customers do not know about your high quality product), or a low quality product, undesired by customers, regardless of the marketing effort; or you have an obsolete product, undesired by customers, regardless of marketing effort. Solution to this problem is to identify it from the above three problems (or combination thereof), and doing something about it.

Production Constraints:

Production constraints are generally of three types: 1) P*olicy constraints*-company or union policies or practice creating the constraint and impede its long-term solution. 2) *Machine capacity constraints*-a single (or small number of) machines on a line forming a bottleneck and 3) *Labour constraints*-insufficient labour (either a skilled operator) or the general labour pool are running a line to full capacity, including extra shifts if needed. In-process inventories between production steps are often a symptom of a production constraint.

Raw Material Constraints:

Raw material constraints include shortages in the short or long term of one or more essential ingredients necessary to making the product. This is why a relationship with one's vendors is so important in TQM.

Sadly, the most frequent constraint is the policy constraint. The cycle in many businesses goes something like this:

1. A problem arises
2. A policy is created to solve the problem
3. The situation changes eliminating the original problem
4. The policy remains and causes a constraint on production
5. Change is emotionally difficult, therefore the policy is lived with and worked around

Thus, resistance to change-inertia turns into a major, long-term bottleneck.

Easing Resistance to Change:

Remarkably, both TQM and Goldratt come to amazingly similar conclusions about instituting progressive change within an organisation. Both philosophies view employees as the key to change. Both philosophies agree that the solution to a problem must be internalised (bought into) by the employee group.

The TQM Solution to Initiating Change:

In total quality management, root cause analysis, in teams, is a major method for initiating and creating essential change-to solve a problem or to improve a process. Not only does the problem get analyzed and solved, but the solvers of the problem are also typically those who implement the solution to the problem. Thus, the inertia of the system is overcome. The workers solve the problem. Management does not have to change worker attitudes prior to implementing the solution to the problem. By having the workers solve the problem, buy-in is assured.

Goldratt's Solution to Initiating Change:

Goldratt proposes what in essence is a dual concept solution to the problem of initiating change in an organisation. The first concept is the use of the Socratic method--a teaching strategy employed by the Greek philosopher, Socrates, with his pupils. I n the Socratic method, a questioner-typically the teacher-attempts to have the students create or *induce* a solution to a question or problem by asking them questions that lead them in the direction the answer or solution. This process continues until the student finds the answer. When this method is

successful, the person implementing the solution has found the solution for himself or herself. Buy-in is assured. Goldratt suggests that this be done by using a second concept, that of the effect-cause-effect method of proof.

In the development of every science, three distinct stages exist:-

1) Classification
2) Correlation (or theory)
3) Effect-cause-effect

Goldratt proposes an useful analogy that points out the parallel between the development of astronomy and economic relationships that exist within a business enterprise. The following discussion, closely parallels Goldratt's discussion:

In astronomy, for example, the ancient Greeks classified the stars in the sky according to their position in the heavens creating the *Zodiac* is still used in astrology. The stars that moved around and violated this classification system (these were the planets) were called *moving stars*. Thus, they provided a classification system for the stars-the first stage. Nearly a thousand years later Ptolemy in Egypt first postulated the first correlation on planet movement--that they travel in a circular path whose center moves along another orbit-circle having Earth as center. Almost a thousand years later, Copernicus added power to the theory of *heavenly body movement* suggesting that, the Sun should be the center, rather than the Earth. Five hundred years later Kepler suggested that the orbits were elliptical rather than circular.

The entire theory or correlation was developed by observation. No one had yet suggested *WHY* the heavenly bodies moved as they did.

Sir Isaac Newton was the first scientist to develop an answer to the question "*Why do the heavenly bodies behave as they do?"* His explanation was gravity--that bodies attract each other in proportion to their masses and inversely proportional to the square of distance between them. Now, one could explain the behavior of all types situations, both new and old. Newton's theories were the guiding physics behind artificial satellites and space travel. Astronomy had reached the *effect-cause-effect* stage.

About 30 years ago, both in the United States and in Japan, production scheduling was systematised with the use of MRP (Manufacturing Resource Planning). For the first time, a systematic approach was taken to shop floor scheduling-bills of material, routings, inventory files, work-in-process files and order files were all organised into a single data base. This was really the first stage-classification. The United States took many years to accomplish and assimilate the first stage. The Japanese moved almost immediately to the second stage-correlation. Dr. Taichi Ohno, Executive Vice President of Production at Toyota discovered the

correlations or theories called the *Toyota Production System* and the Kanban approach, which in the U. S. were combined under the name of Just-In-Time (JIT). Dr. Ohno never asked the question "*WHY?*" He is reputed to have said - "*My system does not make sense at all but, by God, it is working.*"

Prescribing Simple Solutions to Problems:

Once the root cause of the problem is identified, having the relevant group, identifying a methodology to remove the problem becomes the next challenge. Goldratt *never* talks about solving problems at this level, but rather he talks about causing the problem *not to exist*. This is in line with his view of constraints and constraint removal. His reasoned that- "constraint removal is not consistent with compromise and the problem solving in business is typically a compromise". Compromise does not generally eliminate a root cause problem, rather, it works around it. Typically, the compromise is some course of action between the real solution or constraint elimination and a conflicting policy or personality. This is an easier political choice than taking on the more difficult course of both eliminating the real problem and handling the resulting political problem.

2.2.12 Six-Sigma Initiatives

One of the most respected Quality Practitioners; Dr. Edward Deming stated that "The purpose of a school of business should not be to perpetuate the present style of management, but to transform it." (Refer book: Deming W.E. (1993), *The New Economics for Industry, Government, Education*, Cambridge MIT/CAES)

Six-Sigma is a company-wide initiative to generate breakthrough results in business performance. The term Six Sigma also represents a quality measure of Product, Process, and Transaction with nearly 100% conformance. These tools are not new, but do often many companies use more advanced than those traditionally. Six Sigma is mostly old quality technologies dating since 1980s. Sigma is a measure of conformance to specification. As non-conforming rate decreases, Sigma rating increases. The Sigma rating is based on the distribution of a process output as related to a customer requirement. The short-term variability of the process output is such that the upper specification limit (USL) and the lower specification limit (LSL) are both three standard deviations (called Sigma in statistical parlance) away from the centre. Recognizing that most processes shift somewhat over a long period of time, an arbitrary change of + or – 1.5 Sigma is expected to happen, leaving 4.5 Sigma between the shifted average

and the specification limit. This means that a process running at a Six Sigma level in the short term can tolerate a relatively large amount of drift and still make only 3.4 PPM (Parts Per Million) nonconforming over the long term.

With such successes and strong business leaders like; Jack Welsh and Bossidy, the demand for Six Sigma has exploded. Many Fortune 500 companies have begun Six Sigma initiatives and others have asked if Six Sigma is right for them. Numerous consulting firms have jumped on the bandwagon, including ASQ, and numerous articles and books have appeared on the subject. Many product and service advertisements are now mentioning Six Sigma.

Many quality practitioners viewed improving quality as the only objective. As a consequence, they often achieved improvements in quality that did not always translate substantially to the bottom line. While it is generally true that improvement in quality will translate into improved profitability, improving quality is not always the most effective way to improve profitability. The Six-Sigma Qualtec shows, how improvement in the sigma level decreases the Cost Of Poor Quality (COPQ). Six Sigma initiatives seek to drive out measurable costs of poor quality, therefore, projects are selected based upon financial return, typically $100,000 minimum. Some businesses claim an average return of $175,000. American management is realising there is money on the table to be had.

This new philosophy teaches that "quality isn't free. It is profit generating". The new approach has a strong customer focus and requires a business commitment for Six-Sigma, the same level required for a Total Quality Management implementation and total organisational desire to implement Six-Sigma. GE's (General Electric) commitment to Six Sigma is exhibited by tying 40% of executive incentives to Six-Sigma achievements and requires Black Belt training to be considered for promotion. GE puts Master Black Belts in variable incentive compensation plans based on the savings they achieve. These savings do not come for free. Significant resources are needed to support the effort. The Six Sigma methodology declares that the '*Seven Basic Tools*' are not enough. Advanced statistical methods are required for breakthrough cost improvements. A disciplined improvement strategy is required, instead of just teaching basic tools to everyone. Financial analysis is necessary, not just '*nice to do*'. And finally, a disciplined deployment structure is critical.

The quality tools used to improve the sigma level (through reducing variability and cost) have been around for decades. By creating an organised structure and an easy to understand measures of non-conformance linked to costs, a Six Sigma initiative gives managers, good financial reasons to continually improve the process output.

There are several generic implementation phases for Six-Sigma:

1) Establish Management Commitment
2) Business Diagnostics
3) Develop the Management Infrastructure
4) Business Process Identification and Metrics
5) Project Selection
6) Deployment
7) Training
8) Project Execution
9) Review

Six-Sigma uses the very best from *Total Quality Management*, *Process Control*, *Statistical Analysis and Control*, and a new paradigm of *Total Customer Satisfaction* to deliver almost zero defects - and it can also deliver up to a 25% increase in profits.

Six-Sigma has helped GE and other companies achieve astounding operating success and process improvements in the following areas:

- Cost Reduction: The estimated cost of defects from Three-Sigma to Four-Sigma performance (average for most US companies) vs. Six-Sigma is as much as 10-15% of a company's revenues. For GE, this translates into $8 to 12 billion.
- Customer Service: GE recognizes that only products that are virtually defect-free will be able to meet the demands of customers.
- Employee Productivity: As Black Belt project leaders multiply and train more people, and those people get involved in projects, the productivity impact is exponential.

Motorola learned about quality the hard way: by being consistently beaten in the competitive marketplace. When a Japanese firm took over a Motorola factory which manufactured television sets in the United States, they promptly set about making drastic changes in the way the factory operated. Under Japanese management, the factory was soon producing TV sets with 1/20th the number of defects they had produced under Motorola management. In the late 1970s and early 1980s the company responded to the competitive pressure by engaging in a publicity campaign decrying *'unfair'* competition and calling for political protection solutions. Finally, even Motorola's own executives had to admit "our quality stinks"- Main, (1994) and Motorola decided to take quality seriously. Motorola's CEO at the time, Bob Galvin, started the company

on the quality path and became a business icon largely as a result of what he accomplished in quality at Motorola.

Today, Motorola is known worldwide as a *quality leader*. To accomplish its quality and total customer satisfaction goals, Motorola concentrates on several key operational initiatives. At the top of the list is '*Six-Sigma Quality*',the statistical measure of variation from a desired result.

Reducing the *'total cycle time'*-the time from when a Motorola customer places an order until it is delivered-is another vital part of the company's quality initiatives. In fact, in the case of new products, Motorola's cycle-time reduction is even more ambitious; the clock starts ticking the moment the product is conceived. This calls for an examination of the total system, including design, manufacturing, marketing, and administration.

Motorola management demonstrates its quality leadership in a variety of ways, including top-level meetings to review quality programs with results passed on through the organisation. But all levels of the company are involved. Non-executive employees contribute directly through Motorola's *Participative Management Program* (PMP). To reward high-quality work, savings that stem from team recommendations are shared.

To ensure that employees have the skills necessary to achieve company objectives, Motorola spent in excess of $170 million on worker education between 1983 and 1987. About 40 percent of the worker training provided by the company is devoted to quality matters, ranging from general principles of quality improvement to designing for manufacturability.

Motorola knows what levels of quality its products must achieve to top its competitors. Each of the firm's six major groups and sectors has benchmarking programs that analyze all aspects of a competitor's products to assess their manufacturability, reliability, manufacturing cost, and performance.

As a result of these efforts, Motorola can now perform such feats as building pagers and cell phones in lots ranging from one unit to 100,000. Through mass customization the factory can fill a precise order within minutes of receiving it. Thanks in large part to its Six Sigma activities, the company dominates such key high-tech industries as pagers, cell phones, and mobile communications, and is a significant force in many others.

CHAPTER-3

WCM: CONCEPT, METHODOLOGY, TOOLS & TECHNIQUES AND IMPLEMENTATION

3.1 THE WCM APPROACH

The organisational culture is one of the key factors that determine the success of a corporation for several reasons. "The organisational culture represents the set of assumptions, values, beliefs and norms that is shared among its members." (Refer book: Charles O' Reilly (Summer 1989), *Corporations, Culture and Commitment: Motivation and Social Control in Organisations,* California Management Review.) "It gives an identity to employees in defining the vision of what the organisation represents. It is also an important source of stability and continuity to the organization, which provides a sense of security to its members." (Refer book: Newstrom, J.W. & Davis, K. (1995), *Organizational Behaviour: Human Behaviour at Work*, Tata McGraw-Hill, New Delhi.). "Culture, although basically resident in people's minds, becomes crystallised in the institutions and tangible products of a society, which reinforces the mental programs in their turn". It becomes therefore necessary that - organisational culture helps in stimulating employee's enthusiasm in their tasks. It is firmly believed that an organisational culture can be consciously created by its key members and consolidated in such a manner that on one hand it enhances organisational efficiency and profitability and on the other hand offers long term and multi-purpose gains to its employees. This is primary background of the process where formulating WCM unified strategy began.

WCM is a unique strategy for Enterprise Excellence through focus on manufacturing. This strategy encompasses the essentials of most of the labelled 'change initiatives' in the World for managing manufacturing. It is a long-term structured approach which is a cyclical [PDCA-Plan, Do, Check, Act], comprehensive and systematic business tool. The process involves a cultural transformation leading to an '*Abnormality Free Culture'*. It focuses on people, process and results on a continuous basis aiming for delight of stakeholders, including customers and employees through focus on sustainable and superior QCDIP performance and

other parameters.

WCM program aims at improving Nation's competitiveness and business excellence through breakthrough and continuous innovations supported by a team based management system. It strives for **Zero Loss Culture** coupled with highest standard of quality and productivity.

WCM *offers an opportunity to a corporation* to become the champion of the champions in global market so as to become a Leader to be benchmarked, to develop a sense of pride amongst its employees, to satisfy and delight its customers, and to add value to the stakeholders, in particular and the society in general

WCM helps to put in place 'improvement processes' that are self inspired, all round, continuous, systematic, sustainable, simple and participative by individuals in teams.

These improvement processes lead to a 'thinking mind' that:

- Understands the best standards in different areas of workplace
- Is committed to implement such standards at the work place
- Instantly notices and rejects deviations from standards; also known as '*Abnormalities*'
- Likes to establish the "root cause" of non-conformance to standards
- Is keen to eliminate the source of deviation at the root level
- Takes pride in restoring and maintaining the original standards
- Innovates for improvement of original standards
- Cares for the customer, internal as well as external
- Refuses to accept non-value-adding activities
- Develops a killer instinct; wants to be recognised as the best Internationally
- Looks upon the Group as the best place to work in

WCM process tackles the issue of improvement from all angles providing an all-encompassing approach. From CEO to chauffeur, everyone is involved in this improvement process and is equally responsible for the success of it. Ownership rights are transferred down to the operator level thereby making the Organisation look upwards for the change to achieve Manufacturing Excellence. Motivational and participative leadership provides the top down approach towards the same end.

The WCM transformation process leads to new **organisational culture** with following characteristics:

- Prudent when it comes to spending money including buying or hiring External services

- Highly productive with efficiency levels comparable to the world Standards
- Devoid of Waste (Muda) in any form. Always based on minimum resource requirements, be it equipment, space or people
- Geared towards achieving 'Zero Loss', 'Zero Breakdowns', 'Zero Defects', 'Zero Accidents', 'Zero Pollution' and 'Zero Delay' status
- Market driven, always exceeding customer's expectations
- Innovative in terms of Products and Processes
- The pride of its Employees
- Responsive with 'Speed'

3.2 WCM EXCELLENCE MODEL FOR COMPETITIVE ADVANTAGE

Development of WCM Model

Initially in 1996 focus was on TQM and TPM. **(Refer CD-1, Exhibit-3.1,** Chairman'n Circular, 1996)

Then in 1997 it was realised that groups like "TPM Circles" and "Quality Circles" are more voluntary in nature; Quality and Equipment Efficiency is mandatory. So the concept of Business being run by small self managed teams supported by specialist project teams was added.

During 1998, the effectiveness of Supply Chain Management became a key factor, besides strategy etc. Each of employees needed to identify the Customer (Internal or External), determine the requirements of the Customer (individual or the team/ next process) in terms of QCDIP (what major improvements they needed). Again without the right Mindset (that rejects Abnormalities) and Passion (we had to find ways and means to create Passion) nothing was going to move. So Passion for Excellence had to be the watchword.

The WCM Excellence Model has been depicted pictorially and the meaning/message it conveys has been given in ongoing pages.

Figure 3.1: WCM Excellence Model

First model talked only QCD (**Quality, Cost and Delivery**) then it was realized that in the next Millennium, it is Innovations of Products, Processes that will drive the business, and ensures survival in a difficult market place. Productivity of Resources at every workstation has to surpass what competitors are going for and at the end of day; it is the Pride of all the Stakeholders that will keep the business going. Thus was changed **QCD to QCDIP**.

During some Plant visits it was visualised that the Stakeholders were looking for something more from manufacturing on a sustainable basis. Among the list, first was Quality, then Quantity; therefore "Q" in QCDIP Model now stands for **Quality and Quantity** (earlier it

meant only Quality). "C" still was left to mean Costs. "D" was re-described as Delivery and Speed. Similarly "I" was described as **Innovations and Intellectual capital**, and then came "P" which was re-described to mean Productivity and Pride.

It was realised that **one picture must convey the total story.** The relevance of 6M's cannot be overemphasised. Therefore another inner circle was introduced. This conveys that People (Men and Women), Material, Machines, Methods, Measurements, and Markets are important inputs, and the quality of each input will determine the success or otherwise of our team based inspired structure to achieve superior results.

What this Model tells and how to interpret?

The Model is self explanatory in as much as it visually conveys the key constituents and their linkages for good governance for *sustainable superior manufacturing performance.* It combines in one paper, the approach and the methodology for deployment of the Road Map and associated tools and techniques, and ensures goal congruence between Individuals, Teams, Units and the Groups

The focus is on achieving the World class levels of QCDIP in a global environment (see the background picture in the Model) is hired to deliver Value to the Shareholders and for this purpose, the Vision, Mission and Strategy has to be clearly spelt out and backed by role model Leadership.

In today's World, it is very appropriate to use the Olympics where well equipped and trained teams compete for the Award, and create new records in *performance management.* The outer circle, in the Model, conveys that the business should be divided into small competing teams which are to be inspired. Thus the members have an opportunity to excel, give their best, get recognised and take pride in working for the organisation. Goal congruence is achieved by linking the individual, team and manufacturing performance in terms of QCDIP. But none of this is possible, unless there is a paradigm shift, and the Mindset of people is such that they respect and improve the standards. Rejecting Abnormalities, and Root Cause Analysis, as a matter of daily work management, is part of the Culture. For sustainability, it is essential to create Passion for world class standards and process improvements with a killer instinct.

This is not enough. The Model recognises that the focus has to shift to the 6M's - Men (or People), Material, Machines, Methods, Measurements and Markets. Each of these Ms has to be managed efficiently and effectively with resultant QCDIP from these inputs.

Having specified the key Inputs and Enabling Environment, the Model then tells what exactly is to be done by each team and its member. First remove all forms of Waste (what Japanese

call as Muda). Then move to improve the Work Environment to World Class Standards by implementing the principles of 5S and which is challenging and inspiring to the employees, suppliers, customers etc. Now the basics have been sorted out, so move to implement the principles of Just in Time, and address these three (Waste, Work Environment and JIT) dimensions in your supplier's premises also. Good intentions will fail if the Equipment itself is a source of extra costs due to unutilised potential in the form of improving the Overall Equipment Effectiveness (OEE). Therefore, planned and self-maintenance have to be effective so that Equipment is available when needed, it runs at the speed at which it is required and it produces no defects. Each team/process owner takes note of the Internal/External Customers perception and requirements. Now the basic ingredients of achieving highest levels of quality are ready, and Quality is treated as a Strategic Issue and various tools are deployed for achieving **Six Sigma level or 3.4 PPM defects** in process. Continuous improvement can thus be sustained.

Improving the Liaison, Team Force and continuous Skill Development now reinforces this. Given any of the required Information in respect of customers, products, processes, vendors etc., organisations are now well equipped to remain in the business. Now the focus is on System Simplification and continuous improvement in support services, which helps in reducing costs. Up-gradation of Technology affecting every area of business helps in maintaining competitive edge.

WCM also focus on cost drivers. Thereby it increases Cash Inflows and reduces Outflows on a sustainable basis.

Unique features of WCM Model:

Author submits that the Model and Road Map, along with the Methodology put forward by him is unique in many ways:

- It is wider in scope, capable of deeper deployment with resultant change in culture.
- Traditional Models focus on the ingredients and not on the total meal, but WCM Model outlays a bigger picture covering following areas:-
- It is diagnostic, prescriptive and inspirational plus self-sustaining, something that could be seen as the Art of Governance, not just a program with an *'expiry date'*.
- It addresses the hearts and minds of People; making every employee act as a Doctor examining the patient (Abnormality Identification Exercises on regular basis) sharpens their use of Five senses, makes them think and prompts self inspired actions.

- It is a Four-Tier Model, which conveys a story in one graphic.

  1)Tier One: Outer Circle, call it Purpose, Enabling Environment and Structure

  2)Tier Two: Key Inputs for Process Management

  3)Tier Three: Focus Areas: The Eight Dimension/Fourteen KMFAs for each Team and Business

  4)Tier Four: Result Areas: QCDIP

- The model incorporates, in effect; the best practices, World over. The in-built flexibility of the Model (and its Road Map) permits varying level of emphasis and deployment on the 14 KMFAs, appropriate to business needs and the maturity level of the management process at a particular work place. Emphasises the '*Commonality*' rather than the Diversity.

(Refer CD-1, Exhibit-3.2, WCM Initiatives and Maturity Level)

- Generally not defined in any other model, WCM Model defines the structure in clear terms:-

  1. WCM Secretariat (consisting of full time and part time facilitators)
  2. Sub-Committees/Group of Champions (consisting of part time members) for one or more of the Fourteen KMFAs
  3. Volunteers/ Observers

This type of structure ensures involvement of the maximum number of people as "mini teachers/guides" and in this capacity, the system makes it obligatory on them, to come out with ideas and ensures their implementation for improved customer led QCDIP.

- The Strategy for Deployment is little different. Here, the first task is to build the Will and establish Common Language (of WCM) for all employees.
- To change the mode of governance from several layered hierarchical to 2 to 4 layered team structures with a clear definition of –'*Who the team's customer is and What do they want in terms of QCDIP.*' This is followed by open Competition for delivering customer delight (under the sub heading QCDIP). Competition is backed by the ability to "Demand" Performance Improvements in Processes, not just Results. Due Diligence Certificates accompanies following monthly financial results:-
- Identification of issues, major or minor, through '*self diagnostics*' so that their resolution will not meet the resistance from the '*own people*'.
- Through one common Model, it is possible to address the issues in converting inputs into outputs, right from customer to design, procurement, manufacture, delivery and post delivery service, understanding of customer perceptions and then redesigning the product and processes as the required '*Thinking Mind*' is basic to these activities.

- It covers management of all types, be it daily, weekly, yearly, strategic or operational from the manufacturing point of view.
- All forms of Management are integrated here, be Management by/for Objectives or Customer Driven Manufacturing or People Development aspects.
- WCM methodology takes care of the actions needed to sustain the momentum
- It ensures total employee commitment, and deep analysis of issues.
- The variety and the agility of its controlling system, through Visual Management, and series of Competitions are an unique feature.
- Complete transparency is ensured through focus on Visual Management and linkages with Employee Appraisals.
- *'E-governance'* is addressed under Supply Chain Management, Information and Technology KMFA's

It has aroused belief and created a passion, which makes the employees imbibe the principles of good governance '*Heartily*'.

It has broken barriers between Labour Unions and Management staff and has reduced, if not eliminated the conflict of goals. No additional pay outs are required

WCM Model is an Amalgamation of bottom up and top down approach:

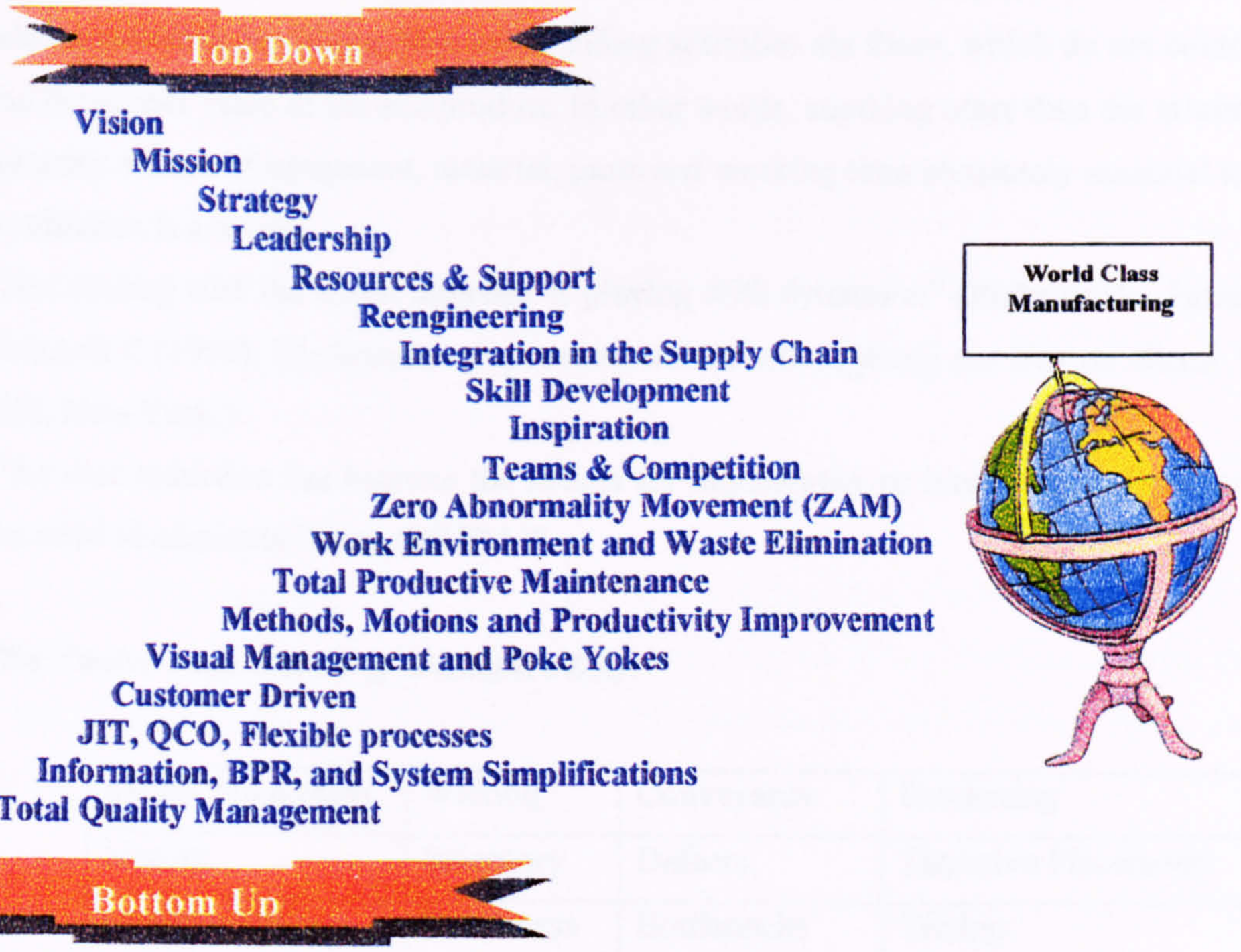


Fig 3.2: WCM – Top Down - Bottom up Approach

3.3 THE EIGHT DIMENSIONS OF WCM

1. Waste (MUDA) Elimination
2. Work Environment (5S)
3. Just-In-Time (JIT) & Supply Chain Management
4. Equipment Effectiveness (EE)/ TPM
5. Quality First: Strategic Quality Management (SQM) and Best Practices
6. Customer Driven: Internal & External
7. Liaison, Team Force & Skill Development
8. Information, Systems, Technology and Cash Flows

3.3.1 WASTE (MUDA) ELIMINATION

Waste exists in several forms, it exists in known form and also in an unknown form. The unknown form is far higher than the known form like the *tip of iceberg*. Waste is anything that the customer does not look for or the customer does not wish to pay for. All the non value-adding activities are Waste. Non value adding activities are those, which do not contribute to the functional value of the end product. In other words, anything other than the minimum quantity of cost of equipment, material, parts and working time absolutely essential to production is a waste.

"Not dealing with the **waste monster** is playing with dynamite." (Refer book: James, Lomax Kenneth C (1999), *Performance Improvement Methods-Fighting the War on Waste,* McGraw-Hill, New York.)

"As cost reduction has become the means for maintaining or increasing the profits, there is the need to eliminate Waste (MUDA)"

The Twelve main classes of Waste(MUDA):

Excess Production	Waiting	Conveyance	Processing
Motion	Inventory	Defects	Tentative Placements
Communication	Untidiness	Bottlenecks	Timing

Table 3.1: Categories of Waste

1) Waste in Excess Production:

"Piles of excess production is piles of losses"

To eliminate waste at any stage of the production systems, three JIT principles are applied strictly:

- Sell it, and then make it.
- Plan backward and
- Pull instead of push.

Excessive production results in consumption of more raw materials and payment of wages for unneeded work, thereby creating unnecessary inventory which in turn requires additional handling of material, additional space, etc.

2) Waste in Waiting:

Ostensibly, it appears that everything is running smoothly; in reality there is massive waste.

A considerable amount of time is lost in supervision of any machine. It can be reduced by:

- Sensors which alert an operator if something is wrong
- Assigning an operator to a group of machines, instead of only one
- Grouping machines which do not require human supervision

3) Waste in Conveyance:

Most manufacturing operations involve a series of delays caused due to bad plant layouts and long distance transportation. They may also result in multiple handling of parts that have been put away in a disorderly manner or stored in a temporary storage. So Plant layout has to be designed in order to avoid waste in movement.

4) Waste in Unnecessary Processing:

Any process that does not add value should be eliminated. Some processes that seem to add value may actually be wasteful. For example in Process Industries, blending is often a part of the process to homogenise. However, if consistency is achieved in the process, blending becomes unnecessary.

5) Waste in Inventory:

'Inventory is an Evil'

In textile, the yarn, which is used as fabric material, may be of thousand types according to

colour, shade, count and blend. Managing such a huge variety in small lots require close attention to procurement, planning, specifications and procedures.

Muda in Inventory is often a huge source of waste in organisations. In the traditional accounting, inventory is seen as an asset while in true sense it is a liability.

"It happens that when a company manages its process poorly, wastes in the form of inventory piles-up." (Refer book: Schonberger Richard j. (1996), *World Class Manufacturing: The Next Decade*, The Free Press, New York)

6) Waste in Motion:

Every unnecessary motion means loss of time. The successful approach is to try and eliminate its need in the first place. Identifying unnecessary motions requires challenging long held assumptions and practices e.g. imagine a pump was to deliver material at a specified point in certain quantity in batches. The general practice is to run the pump continuously at lower discharge rate into a intermediate reservoir. Alternatively a bigger pump running intermittently can be installed. The approach should be to avoid the idle running or under-running/over-running of the pump.

In a work place itself, considerable wastages in motion can be eliminated by organising the tools materials etc.

7) Waste in Defects:

Defects and Reprocessing are unnecessary and expensive, though very often they are mistakenly considered as inevitable. The World is presently seeing a major change in Mindset where *Zero Defects* are beginning to be accepted as a reality.

Elimination of defects through reliability of strengthening the Process, Suppliers, Materials, Operations, and Equipment etc is widely practised in several organisations leading to substantial reduction in defects.

8) Waste in Tentative Placement:

Tentative placements results in non value adding operations like handling, searching etc. A tentatively placed item is sometimes not available at the required time resulting in fresh procurement. Only those things, which are needed for immediate operations, should be kept near the workplace all the other essential things should be kept at a proper storage place. Things should not be placed tentatively just for the sake of their probable use at any time.

9) Waste in Communication/Procedure:

Misunderstanding results in delay and waste, including most significantly, lost opportunities. Despite their importance, communications are usually taken for granted, instead of being seen as something, which needs to be managed almost as a science. Good companies appraise executives upon the clarity of their communications.

Lack of Communication, unclear communications etc. often result in huge wastages. For example people turning up for meetings, which is postponed, production working on wrong priorities leading to creation of inventory and loss of sales.

Paper work absorbs time. The shorter and simpler an organisation's administrative procedures (including decision making processes), the least is the waste and scope for any error. Large firms are particularly prone to administrative inefficiency, because their very large size makes them vulnerable.

10) Waste in Untidiness:

Untidiness slows down the value delivery systems. Delays occur due to some of the way round obstacles and/or lost time in searching for tools, documents, forms and so forth. Orderly working procedures eliminate the need for periodic re-arrangements. Untidiness and cluttering can also cause accidents and resultant wastage.

11) Waste in Bottlenecks:

Bottleneck not only disrupts progress, results in delay, causes damage but may also result in loss of customers and increase in cost. Consequently, the secondary effects can be far reaching.

Fabric Length → (Metres/Hour)	1500	5400.	1800	1800	1800	4200
Fabric → Processing Step-by-step	Heat machine Setting machine	Singeing machine	Scouring machine	Drying machine	Chemical finish machine	Mechanical finish machine

Table 3.2: Example of Bottleneck

The table shows that the capacity of a fabric processing system as 500 Metres per hour, because production is determined by the slowest strand of the process. In actual process, the production is lower than the theoretical maximum, because the product tends to pile up at the bottleneck. Instead of trying to improve the system or de-bottlenecking by investing in new or additional equipment or managers exerting staff to work round o'clock and de-motivating difficulties, the bottlenecks in equipment, processes, systems, procedures etc. should be found out and eliminated. Accepting bottlenecks as part of the process is letting 'Waste' thrive in the organisation.

12) Waste in Timing:

Speed demands careful attention to logistics. Delays are less about shortage of time and more about the effect of timing. In other words, when something is not done on time, it usually really means it was not done with proper timing. A major reason for untimeliness is sequential thinking. Much time can be saved by structuring activities concurrently i.e., identifying tasks that can be carried out simultaneously.

Several proven tools and techniques are available for eliminating 'waste'. However, the most important thing is to **create a *Mindset* that does not accept '*Waste*'**.

3.3.2 WORK ENVIRONMENT (5S)

5S, which stands for good housekeeping concepts, is considered the basis for continuous productivity and quality improvements. The good housekeeping and workplace organisation are directly linked to achieving discipline in manufacturing. In addition, good housekeeping and workplace organisation will result in better compliance to schedules, fewer machine breakdowns, lower defect rate, and prompt exposure of problem areas.

5S – The 5 Steps	
Seiri	Sort out unnecessary items in the workplace and discard them
Seiton	Arrange necessary items in good order so that they can be easily picked up
Seiso	Clean your workplace completely so that there is no dust on floor, machines and equipment
Seiketsu	Maintain high standard of above at workplace / organisation at all the times
Shitsuke	Train people to follow good housekeeping discipline autonomously

Table 3.3: The 5 Steps

Following are the areas for establishing 5S system:

Eliminates Wastes	Improves Effectiveness
Promotes Cleanliness	Prevents Breakdown
Ensures Quality	Improves Safety
Is Self-sustaining	Makes an employee feel proud of his workplace

Table 3.4: 5S Objectives

What does one get from practising 5S?:

Employees	**Organisation**
▪ Create work effectiveness ▪ Create more vital working atmosphere ▪ Cheerful / good mood ▪ Safe environment ▪ Higher work efficiency ▪ All working areas are in proper order ▪ Pride	▪ Increased production efficiency ▪ Reduction in stock ▪ Reduction in production cost ▪ More space and storage area released ▪ Safe and healthy work environment ▪ Satisfied employees making positive contribution to the company ▪ Elimination of several hidden wastes ▪ Obvious Factory/ Parlour Factory

Table 3.5: 5S Outcomes

3.3.3 JUST-IN-TIME (JIT) & SUPPLY CHAIN MANAGEMENT

JIT philosophy says an organisation must be highly responsive to the needs of the customer be it External or Internal. A set up devoid of non-value adding activities is a must for JIT. Responsiveness is a function of cycle time. JIT hence focuses on Time Compression to cut down cycle times in all processes.

The JIT approach is universally applicable and can work in any manufacturing environment. In fact, it can work in non-manufacturing industries as well. JIT principle can be used anywhere even at home. It is a manufacturing strategy to meet today's challenge of

competitive survival.

The supply chain deals with processes commencing from sourcing of material to ultimate customers. Isolated working of the parts does not get the desired results. The emergence of Internet has paved the way for information integration. An effective management of inbound and outbound logistics strengthens supply chain management.

7 Elements of JIT

There are seven elements of JIT philosophy, six different internally focussed elements and one externally focussed element.

- The First focussed element is the JIT philosophy itself.
- The Second is quality at source.
- There are Three manufacturing engineering elements:

a) Uniform plant load,

b) Overlapping operations (machine cells), and

c) Minimum set-up time.

- The Sixth internally focussed element is type of control called Kanban, a pull system or linking operations.
- The Seventh externally focussed element is JIT purchasing.

The Principle of JIT Production:

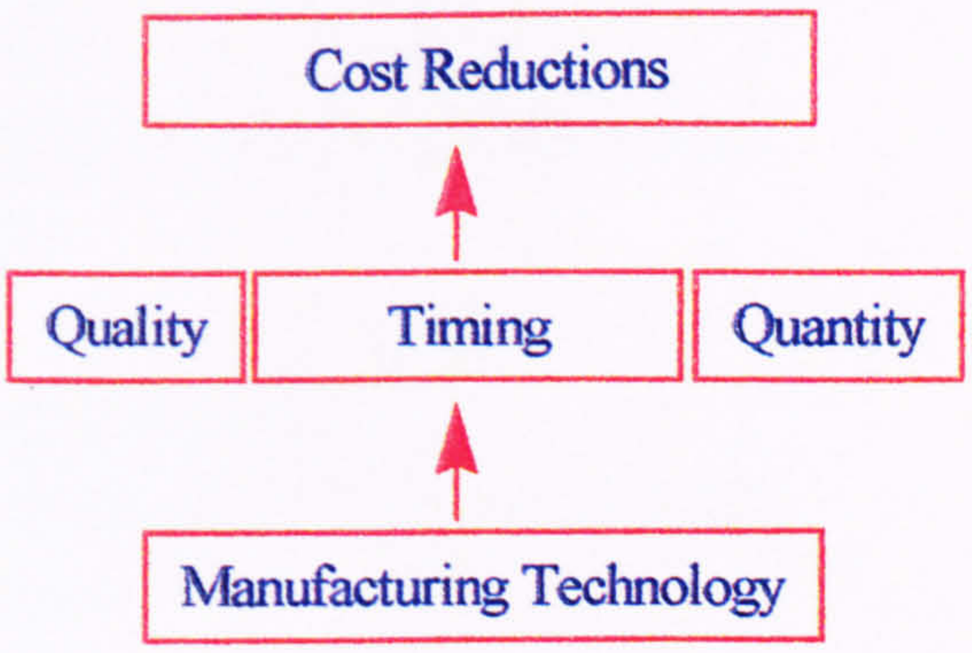


Figure 3.3: JIT Production Principle

Throughput time: An Indicator of responsiveness

Throughput time is an important indicator of manufacturing effectiveness and organisational responsiveness. Time compression helps in achieving throughput time reduction.

Example of a Typical Throughput time elements:

A= receiving time 3 days, B= Storage 12 days, C= Process 1 day

D= WIP 5 days, E= Process 1 day, F= Process 1 day,

G= FG storage 16 days, H= Dispatch 4 days.

Total Cycle Time = 43 days

Value adding act. = 3 days (only process days)

Non Value adding = 40 days

Figure 3.4: Throughput Time – Before

Now if we try to reduce the non-value adding activities we can achieve a Total Cycle time of 16 days

Figure 3.5: Throughput Time – After

The cycle time has reduced from 43 days to 16 days due to reduction of the non-value adding activities significantly adding to the cycle time.

Some of the Throughput Time Reduction Techniques are:

a) Cellular Manufacturing

b) Set up time reduction

c) Parallel instead of sequential scheduling

d) Elimination of NVA (Rework, Inspection, MH & Waiting)

e) Elimination of Breakdowns

f) Elimination of Defects

Cellular Manufacturing: A logical arrangement and sequence of all facets of company operation in order to bring the benefits of mass production to high variety, mixed quantity production. As far as possible a product should move within the cell allotted. The advantages are:- 1) Reduction in material handling. 2) Reduction in throughput time.

Set-Up Time/Changeover time: The time required to make changes in the Machine/ Equipment/Process in order to enable it to produce a product of different variety than the one, which it was producing prior to the set-up, change.

Set up time reduction is achieved by:-

- Separate internal activities from the external
- Convert as much of internal set up to external
- Eliminate the adjustment process
- Abolish the set up itself (keep uniform parts for all products, make multiple products at same time on one single machine)

Parallel Scheduling v/s Sequential Scheduling

Sequential Scheduling: The product moves from one operation/machine to next only after the entire lot is ready.

Parallel Scheduling: The component is moved from one operation/ machine to next on a single piece basis. This way the lot moves parallel and the total throughput time for the entire lot is considerably less.

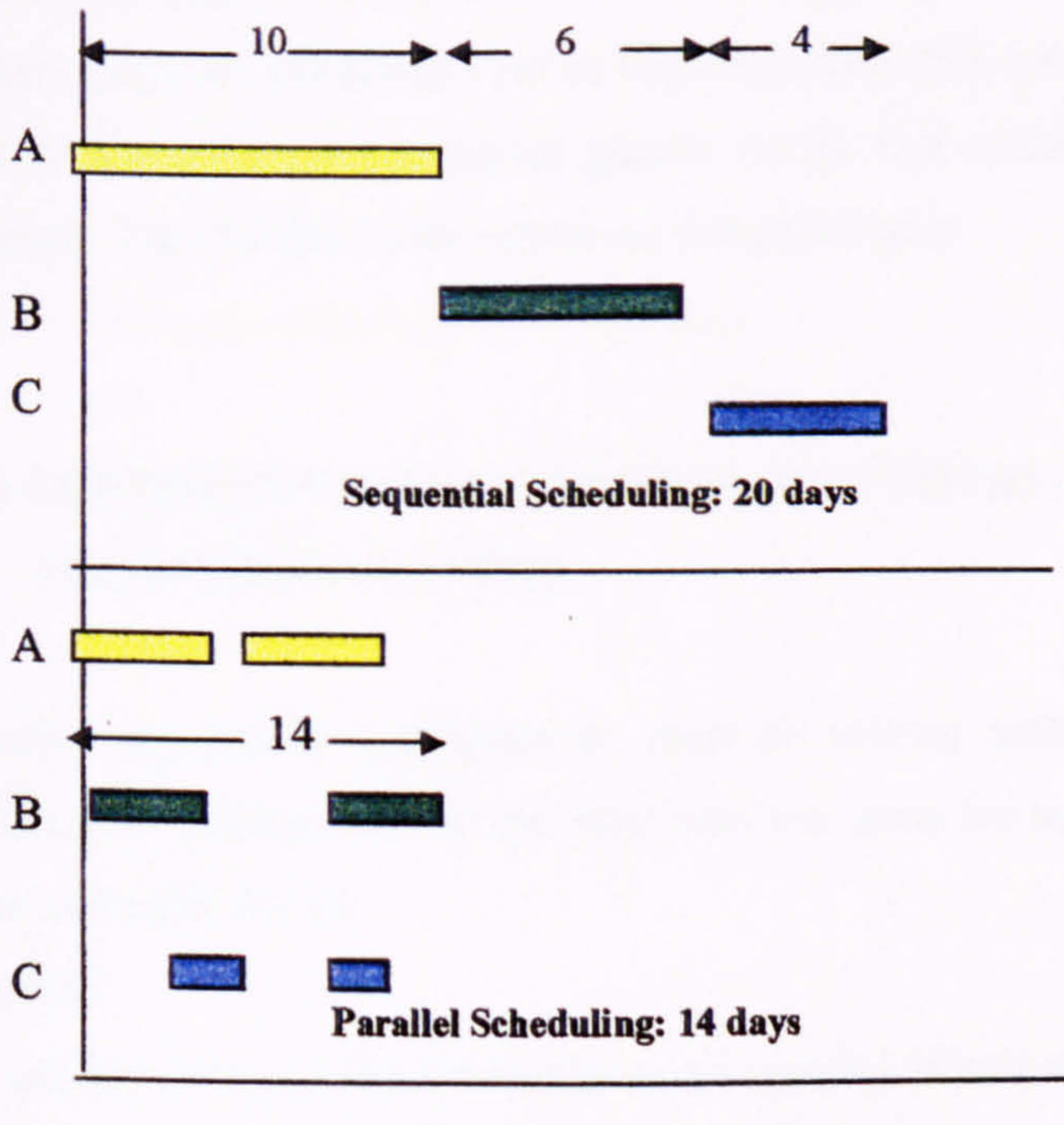


Figure 3.6: Parallel v/s Sequential Scheduling

Planning for JIT

The real goal can only be achieved when JIT is implemented throughout the supply chain. For this reason, customer/ supplier relationship is a key feature in the achievement of JIT.

Basic Principles:

Incoming goods: No buffer stock of anything: Plant must be kept in good working condition at all times using planned maintenance routines.

JIT requires intensive application of employee involvement programs, particularly those where problem-solving techniques are incorporated. JIT says, as far as possible material should be directly delivered to point of use.

The Push/ Pull Systems:

Pull system: Produce on customer demand.

Push system: Produce to forecasts of demand or make to stock.

Reliability and Flexibility in the system are essential for operating in the 'Pull' way.

Workplace Control: The KANBAN System:

Kanban is a card. It is a work order sheet or tag subject to repetitive circulation in the field.

Kanban plays an important role in implementing Pull system. It refers to a work instruction sheet or job order in transparent plastic folder that accompanies the pallet holding parts or materials. This Kanban goes wherever the pallet goes.

(Refer CD-1, Exhibit-3.3, JIT Examples)

3.3.4 EQUIPMENT EFFECTIVENESS (EE)/ TOTAL PRODUCTIVE MAINTENANCE (TPM)

Effective equipment management aims at setting activities and systems which prevent breakdowns, quality defects and eliminate the need for equipment adjustments to make work easier and safer for all.

Why EE?

The quality of the product depends on the quality of process and the equipment.

EE is an equipment management program, which involves all functions including production, maintenance, development and management together to put up a practical shop floor system and prevents all losses before they occur throughout the life cycle of the system to create a

Zero Abnormality Culture. EE prevents the accelerated deterioration of the Equipment/ System.

Overall Equipment Effectiveness (OEE):

The measure for Equipment Effectiveness is ***Overall Equipment Effectiveness***, which is a function of Availability, Performance Rate and Quality Rate.

Overall Equipment Effectiveness = Availability x Performance Rate x Quality Rate

$$\text{Availability} = \frac{\text{Actual On Stream Days}}{\text{Calendar Days}}$$

$$\text{Performance Rate} = \frac{\text{Actual Production/ On Stream Days}}{\text{Target Production/ Target On Stream Days}}$$

$$\text{Quality Rate} = \frac{\text{Actual Production} - (\text{Quality Defects} + \text{Reprocessed Quantity})}{\text{Actual Production Quantity}}$$

In WCM approach, focus is on the following areas of Equipment Effectiveness:

- Focused Improvement and Kaizen
- Self Maintenance
- Planned Maintenance
- Initial Flow Control and MP Design
- Safety, Hygiene and Pollution Control

3.3.4 (a) Focused Improvement and Kaizen:

This deals with elimination of all losses in the production and support system. The focused improvement that emphasises on major problems is also supplemented by the small continuous improvements called 'Kaizen'. Kaizen is a concept of continuous improvement in all company functions at all levels. Dr. H. Harrington James has correctly identified the importance of continuous improvement with the quotation "You can't win in today's market place using yesterday's processes" (Refer book: Harrington H. James with Harrington James S. (1995), *Total Improvement Management – The Next Generation in Performance Improvement*, McGraw-Hill Inc., New York.)

Loss Structure:

Loss is defined as some thing that obstructs the full efficiency of production, manpower, utilisation of material and energy. Any initiative to improve the performance efficiency starts with a full understanding of the existing losses. There are *sixteen losses* obstructing efficiency of any plant and these can be categorised under three main headings.

A. Losses Obstructing the Production Efficiency:

Shutdown Losses

Production Adjustment Loss

Equipment Failure Loss

Process Failure Loss

Normal Production Loss

Abnormal Production Loss

Quality Defect Loss

Reprocessing Loss

B. Losses Obstructing Manpower Efficiency:

Management Loss

Operating Motion Loss

Line Organisation Loss

Logistics Loss

Measurement and Adjustment Loss

C. Losses Obstructing Material & Energy Utilisation:

Material Yield Loss

Energy Loss

Equipment Loss

A calculation of losses for all equipment, assembly lines plant gives a true indication of effectiveness of capacity utilisation. **(Refer CD-1, Exhibit-3.4,** Categorisation of Losses and Loss Cost Matrix)

3.3.4. (b) SELF MAINTENANCE

Mere implementation of planned maintenance cannot guarantee fail free equipment as quite often, the abnormalities are noticed by plant/production personnel who are closer to the operation. The principle of 'Ownership' is the driving force behind 'Self Maintenance'.

Self Maintenance means owning department taking the responsibility for preventing

deterioration, establishing and maintaining basic equipment condition (through cleaning, lubrication and tightening). Practicing Self Maintenance, requires thorough knowledge of the equipment and process. (a maintenance competent operator).

The Seven steps of Self Maintenance:

1. Perform Initial Cleaning
2. Address contamination sources and inaccessible places
3. Establish cleaning and checking standards
4. Conduct general equipment inspection training
5. Perform general process inspection
6. Systematic Autonomous Maintenance
7. Practice full Autonomous Management

The three Tools of Self Maintenance Activities:

The three essential tools of Self Maintenance activities are:-

Activity Boards

Meetings and

One Point Lessons

These tools are needed to stimulate vigorous and effective activities.

3.3.4. (c) PLANNED MAINTENANCE

Planned Maintenance is the methodical activity of building and continuously improving the maintenance system. Planned Maintenance includes *Specialised Maintenance* and Self *Maintenance.* A well-balanced and implemented Planned Maintenance system can lead to Zero Breakdown.

The ***Specialised Maintenance*** involves following:-

- Preventive Maintenance
- Predictive Maintenance
- Reliability Centered Maintenance
- Maintenance Prevention

Eight Activities involved in Planned Maintenance:

1. Support and Guidance to Self Maintenance
2. Zero Failure Activities
3. Planned Maintenance Structure
4. Lubrication Management
5. Spare Part Management
6. Maintenance Cost Management
7. Predictive Maintenance
8. Enhancement of Maintenance Technology and Skill

Reliability Centred Maintenance (RCM):

RCM is an important component of Planned Maintenance. It refers to a preventive maintenance program designed to preserve the inherent reliability of the equipment and system. The program emphasises maintenance tasks selected on the basis of reliability characteristics of the equipment and a logical analysis of consequences of failures. Before setting out to analyse the maintenance requirements of the assets in any organisation, one needs to know what these assets are, and to decide which of them are to be subjected to the RCM review process.

3.3.4 (d) INITIAL FLOW CONTROL/UPSTREAM MANAGEMENT AND MAINTENANCE PREVENTION (MP) DESIGN

Maintenance Prevention (MP) is: "Design activities carried out during the planning and construction of new equipment, imparting high degrees of reliability, maintainability, economy, operability, safety, and flexibility, while considering maintenance information and new technologies, and thereby reducing maintenance expenses and deterioration losses." (Refer book: Shirose Kunio (1996), *TPM (Total Productive Maintenance) – New Implementation Program in Fabrication and Assembly Industries, Japan Institute of Plant Maintenance (JIPM)*, Tokyo.)

"Fifteen years ago, companies competed for price. Today it's quality. Tomorrow it's design." (Refer book: Peter Tom, *The Circle of Innovation* – Professor, Harvard Business School)

The basic aim of Initial flow control is to ensure/procure equipment which are maintenance free, of high quality and productivity, yielding maximum life cycle profit, meeting future needs from the stand point of pursuing an ultimate man machine system efficiency. Also, to

speed up implementation of New Projects/New Products by applying upstream management.

Life Cycle Costing (LCC):

"LCC is the direct, indirect, recurrent, non – recurrent and other related cost of systems during their planned effective period; it is the total cost, including the cost that arises or is expected to arise in the processes of design, development, production, operation, maintenance, and support." (Refer book: Shirose Kunio (1996), *TPM (Total Productive Maintenance) – New Implementation Program in Fabrication and Assembly Industries, Japan Institute of Plant Maintenance (JIPM)*, Tokyo.)

Steps involved in initial Flow Control:

Step One: Survey and analysis of present status

Step Two: Establish Early Management System

Step Three: Debugging and Training

Step Four: Full utilisation and incorporate in Design

Early Equipment Management

This deals with intervention in the equipment design stage to ensure maintenance free design and economy of Life Cycle Cost. The concept of Maintenance Prevention Design (MP Design) is applied to ensure that new equipment are trouble free, reliable, easy to maintain and deliver consistent quality and performance expected.

MP Design Attributes are following:-

Reliability

Maintainability

Ease of Operation/Operator Maintainability

Economy in Operation (Life Cycle Costing)

Safety in the system

3.3.4 (e) SAFETY, HYGIENE AND POLLUTION CONTROL

Safety and Hygiene system establishes a work environment that is free from accidents and health-hazards. Ensuring equipment reliability, eliminating danger-prone activities, preventing human error to eliminate accidents, creating environmental friendly/pollution free process and

plant by strict compliances are the basic tenets of WCM.

Following should be Attack and Defence Strategy for minimising the possibility of accidents and pollution:-

- People are trained to know their equipment intimately and are educated to become more safety-conscious. Training also is based on analysis of accidents, near miss accidents and dangerous occurrence.
- It is ensured that everyone understands the importance of establishing, implementing and constantly improving the safety and environmental management system.

Three Safety Principles:

1) Workplace organisation and discipline, 2) Inspections, servicing and 3) Standardisation are all three essential elements in creating a safe workplace and are the basic principles of safety.

Improve Working Environments by Eliminating 3 `D':

A workplace that is easy to work must first be one where people can work without worrying. Creating such a workplace requires getting rid of the "three evils" Difficult, Dirt and Danger.

- **D**ifficult tasks are hard to do right because they are fatiguing
- **D**irt is more than just unsanitary, if neglected, it can cause equipment to break down and create unsafe conditions
- Such conditions create **D**anger in workplace where sooner or later major accidents will occur.

3.3.5 QUALITY FIRST: STRATEGIC QUALITY MANAGEMENT & BEST PRACTICES

Strategic Quality Management (SQM) is the process of establishing **long-range quality goals** and defining the approach to meeting these goals. SQM is developed and led by the upper management. In SQM we integrate quality into strategic planning. The meaning of Quality goes beyond *product quality* - it is **Total Quality**. The pursuit of '**Six Sigma**' approach is an integral part of Strategic Quality Management.

"Quality cannot be inspected out of a product, it must be built in." (Refer book: Lochner H. Robert & Joseph E. Matar, *Designing for Quality*)

"A Quality Management System will not win the game for you but the lack of it can cause you

to lose the game." (Refer book: Harrington H. James with Harrington James S. (1995), *Total Improvement Management – The Next Generation in Performance Improvement*, McGraw-Hill Inc., New York.)

"Quality is like art. Everyone's for it, everyone recognises it when they see it, but everyone defines it differently. Unlike art, nobody takes violent exception to someone else's definition of quality." (Refer book: Schonberger Richard J. (1986), *World Class Manufacturing: The Lessons of Simplicity Applied*, The Free Press, New York.)

"JIS (Japan Industrial Standards) defines 'Quality' as the sum of the performance characteristics that are judged to determine whether a product or service satisfies the purpose of its use." (Refer book: Senju Shizuo (1992), *TQC and TPM*, Asian Productivity Organisation, Tokyo.)

American Society for Quality Control defines quality as follows: "Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs." (Refer book: Kotler Philip (1995), *Marketing Management – Analysis, Planning, Implementation and Control*, Prentice-Hall of India Pvt. Ltd., New Delhi.)

"Product (output) quality is the degree to which the product conforms to the design specifications" (Refer book: Adam Everette E. Jr., Ebert Ronald J., *Production and Operations Management – Concepts,* Models and Behaviour, Prentice Hall Inc., Englewood Cliffs, N.J.)

Approach to SQM:

SQM focuses on customer needs. This focus covers strengths, weaknesses, opportunities and threats (SWOT) analysis. If a significant difference exists, then specific goals and actions must be identified – known as 'Gap analysis.'

SQM involves following activities focusing on SWOT:

- Analysis of Financial goals for the product
- Comparison of present quality goal with respect to competition
- Key quality factors that influence the purchasing decision of potential customer
- Comparison of competition on each key factor
- Internal results on quality
- Alternate quality goals with respect to competition
- Departmental plans and requirement of resources

This is followed by:

- Leadership by upper management to develop quality goals and strategies
- Translation of strategies into annual business plans
- Implementation of actions by line departments instead of relying on a Quality Department

Elements of Management Cycle that develop and implement strategies for Quality:

- Quality policies
- Quality goals
- Deployment of goals
- Plans to meet goals
- Organisational structure
- Resources
- Measurement of feedback
- Review of progress
- Rewards based on performance against goals
- Training

The Strategic Quality Management approach differs from company to company. Depending upon the requirement of the company the approach can be changed. Quality issues can be modified into regular strategic planning process.

Cost of Quality

Quality is tangible and measurable by calculating the PONC (Price of Non Conformance). Most organisations generally segregate Quality Cost into 3 distinct categories, viz:

1. **Prevention Costs**: Cost expended in an effort to prevent poor quality.
2. **Appraisal Costs**: Costs expended on the measurement of quality characteristics to assure conformance to quality requirements.
3. **Failure Costs**: Costs generated by defective products not meeting quality requirements. It includes **Internal** as well as **External** failure costs.

It is interesting to note that the Cost of Quality is generally not known to many organisations. Some calculated figures show as high as 20 to 30% of cost or sales value.

For defect free products, process itself should be defect free. For controlling/ managing the process various techniques are used and SPC (Statistical Process Control) is one of them.

Statistical Process Control

The Statistical technique using methods such as Control Charts to analyze a process or its output so as to take appropriate actions to achieve and maintain optimal process capability and to give opportunities for its improvement.

Process Capability

It is capacity of the process to reach a certain level of quality. If the customer-specified quality expressed in terms of specification limits are known, then process capability is a measure to meet or not meet or exceed the customer's requirements.

Formula:

$$Cp = \frac{USL - LSL}{6\,\sigma\,(sigma)}$$

$$Cpk = \frac{USL - \bar{X}}{3\,\sigma\,(sigma)} \quad \text{or} \quad \frac{\bar{X} - LSL}{3\,\sigma\,(sigma)} \quad \text{whichever is smaller}$$

USL, LSL are specification limits. Cp & Cpk are static and dynamic process capabilities

Interpretation and inferences of Cp & Cpk values:-

Cp ≥ 2.00 - capability is exceeding customer requirement.

≥ 1.33 - desirable, but try to improve

≥ 1.00 - acceptable but must improve

< 1.00 - not acceptable

Cpk≥ 1.33 - desirable

≥ 1.00 - acceptable

< 1.00 - not acceptable

Cp, Cpk can be calculated for data from control charts.

Though, Cpk alone is a comprehensive metric for measurement and control of process, the activities for improving a process are different. Cpk combines the effects of both the Spread and the Shift about the mean. To improve, it is essential to know the effects of each of them individually. Knowing the process spread separately, is only possible through the measurement of Cp. By knowing Cp, we can know about the nature of the process spread and using this information during interpretation of Cpk will give us information about the process shift from the mean.

Six Sigma Approach

It is the use of advanced statistical tools like Hypothesis Tests, ANOVA, Fractional Factorial Experiments, Taguchi Methods, Response Surface Methodology, Mixture Experiments, Regression Analysis, Correlation Analysis, Measurement System Analysis to structured problem solving so as to achieve 3.4 Parts Per Million as defects at all stages of processes.

An approach using such tools described above ensures a roadmap towards achieving Zero Breakdowns, Zero Accidents, Zero Losses, Zero Defects, Zero Pollution, Zero Customer Complaint, etc.

Six Sigma is about improving profitability, although improved quality and efficiency are immediate by-products of Six Sigma. Companies that implement Six Sigma do so with the goal of improving their margins.

Six Sigma savings are as significant in small companies as they are in larger companies.

(Refer CD-1, Exhibit-3.5, Project Report on Six Sigma)

In WCM approach, **Best Practices** are shared amongst the Employees/Department/Units.

3.3.6 CUSTOMER DRIVEN: INTERNAL AND EXTERNAL

The key to high profitability is to become '*customer-centered*'. WCM process advocates that the external customer satisfaction can only be achieved if the internal customers are satisfied.

A prominent management writer has correctly identified the importance of employee's satisfaction for business success and how to get the best from employees with the following quotation:

"If you will put the business in their hearts, they will put their hearts in the business." (Refer book: Creech Bill (1994), *The Five Pillars of TQM – How to Make Total Quality Management Work For You*, Truman Talley Books? Plume Penguin Group, New York.)

"If you are not thinking customer, you are not thinking".– Ted Levitt

"Profit in business comes from repeat customers, customers that boast about your product and service, and that bring friends with them." – W. Edwards Deming

" 'Our job' is to give the client, on time and on cost, not what he wants but what he never dreamed he wanted and, when he gets it, he recognises it as something he wanted all the time".- Sir Denys Lasdun

Only identifying the customer's needs (through customer survey etc.) is not enough. Customer Delight is something beyond it. Note the following statement:-

"Our plan is to lead the public with new products rather than ask them what kind of products they want. The public does not know what is possible, but we do. So, instead of doing a lot of market research, we refine our thinking on a product and its use and try to create a market for it by educating and communicating with the public." - Akio Marita's

"Cutting costs while using the same ineffective process is a symptom of a lack of strategy, not a strategy itself. Strategy is understanding customers in enough detail to identify them, the problems you solve for them, and how you do it so that they are bound to you rather than someone else." (Refer book: Levitt Joel, *"The Handbook of Maintenance Management,")*

Understanding of customer perceptions and expectations about product and services, timely response to all customers, proper market assessment and integration of production plans with market are some of the key areas of this dimension. In order to delight the whole chain of ***Internal Customer*** and the ***External Customer***, each internal customer needs to delight his/her successive customer as a supplier in a "Closed Loop Manufacturing Environment"

Quality Function Deployment (QFD)

It is a tool which is very useful in translating all the quality needs of the customer into the Organisation's functions and consequently into the Product itself in totality.

Quality Function Deployment is one Tool, which provides a link between Strategic Quality Management and the Customer. It is a very powerful technique which enables companies to anticipate and prioritise needs of Customer in totality and to incorporate them effectively into Products and Services provided for end uses.

An example of QFD Matrix for a Safety Belt has been produced on next page.

One must ensure following:-

- Understanding of Customer perception and expectations about the company and competition
- Timely response to all Customers
- Proper market assessment
- Application of Internal Customer concept
- Integration of production plan with the customer plans
- An overall strategy for competitive advantage and total involvement of all employees for implementation

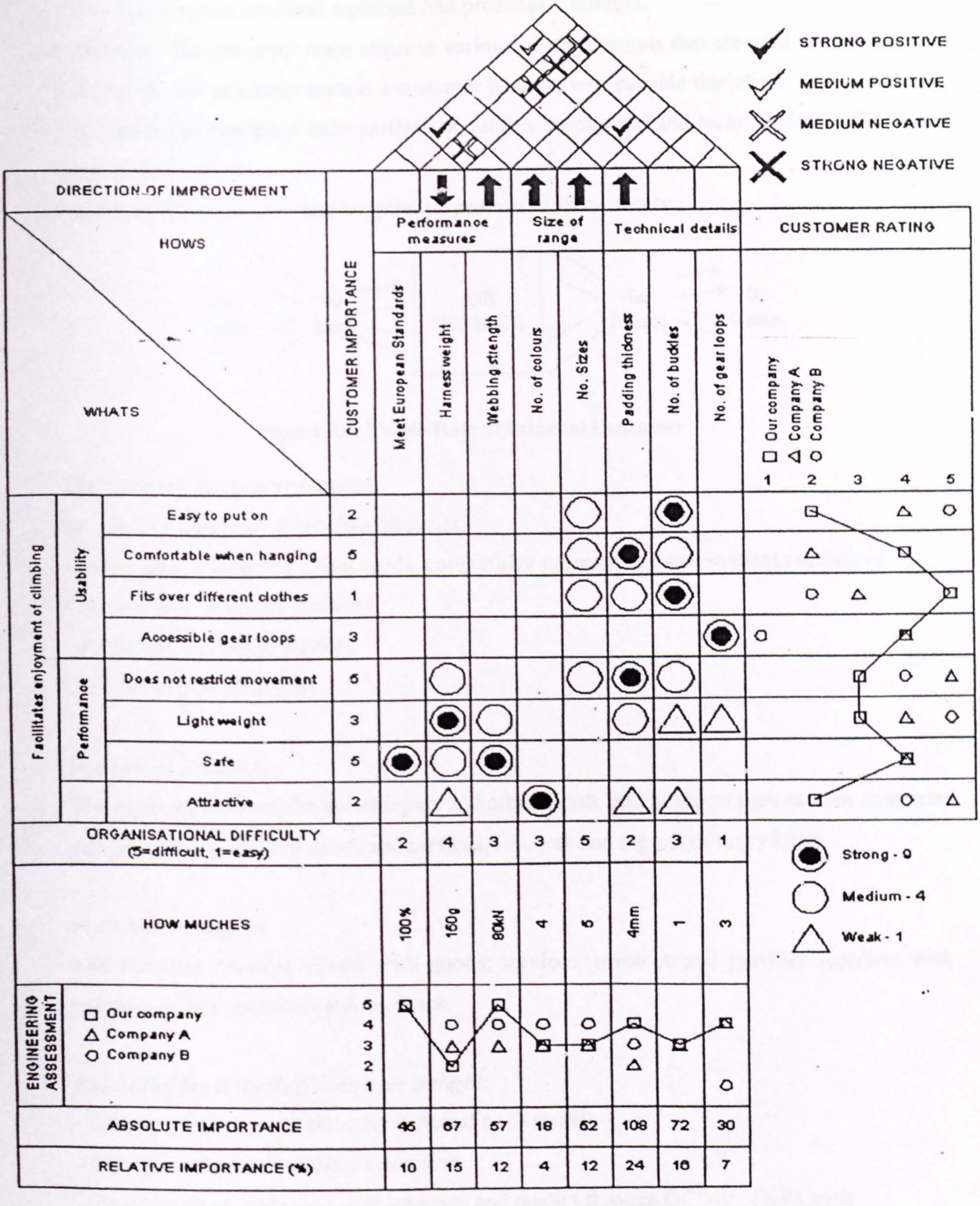


Fig 3.7: QFD for Safety Belt

Triple role of Internal Customer:

Every Process team conducts a process and produces a product.

Customer: The processor team acquires various kinds of inputs that are used in carrying out the process. The processor team is a customer of those who provide the inputs.

Processor: The processor team carries out various managerial and technological activities to produce its products.

Supplier: The processor team supplies its product to its customer.

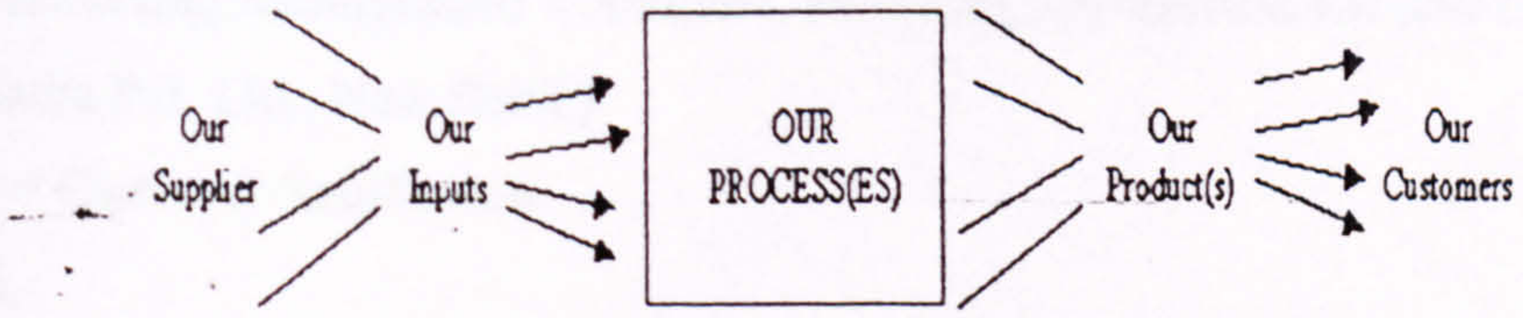


Figure 3.8: Triple Role of Internal Customer

The company is a processor team.

Its role as a customer, it receives inputs as:

- Information concerning client needs, competitive products and government regulations
- Money from sales and investors
- Purchased goods and services
- Feedback from customers

In a role as processor:

The company converts the above inputs and other inputs into products such as sales contracts, purchase orders, saleable goods and services, invoices and reports of many kinds.

In its role as supplier:

The company provides clients with goods, services, invoices and provides suppliers with purchase orders, payments and feedback

Road Map for achieving Customer Delight:

- Identify who are your customers (Internal or External)
- Determine the needs of those customers
- Translate those needs into your language and quality through QCDIP Parameters.
- Develop product features that can optimally respond to those needs
- Develop a process that is optimally able to produce the product features
- Make the product available at, competitive price, and on time

- Give him more value for money he spends through extra product features, which he never thought of

The equation of customer delight is very simple:

"Satisfaction is the level of person's felt state resulting from comparing a product's perceived performance (or outcome) in relation to the person's expectation." (Refer book: Kotler Philip (1995), *Marketing Management – Analysis, Planning, Implementation and Control*, Prentice-Hall of India Pvt. Ltd., New Delhi.)

Q+C+D = Customer Satisfaction

Whereas,

Q+C+D+I = Customer Delight

Where Q = Quality, C = Cost, D = Delivery and I = Innovations

"It is not enough to have satisfied customers. Dissatisfied customers move over to the competition, but you may also lose a satisfied customer to the competition, if he thinks that he has nothing to win or lose by doing so." - Deming (Refer book: Ahluwalia J. S., *Quality for Business Transformation)*

Dr. Noriaki Kano's views about Customer Requirement and Customer Delight:

Dr. Noriaki Kano, who is a member of the Japanese Union of Scientists and Engineers, demonstrates that blindly fulfilling customer requirements has risk associated with it if the product/service provider is not aware that there are different types of customer requirements. Without this understanding and measurement, providers risk are:-

- Providing superfluous quality

- Wooing the customer in one area, and driving them to competitors in another

- Focusing only on what customers say, and not what they think

Dr. Noriaki Kano's Model of customer requirements directs the product/ service provider to pay attention to two dimensions and three types of customer requirements.

The *first dimension* is need fulfillment. Measure the degree to which the customer's requirements are fulfilled. The dimensions ranges, naturally, from completely unfulfilled to completely fulfilled.

The *second dimension* is the customer's subjective response to the first dimension. It is the dependent variable of customer satisfaction. This may range from "irate" to "delighted".

Expected Requirement:

Expected requirements are those that are so obvious to the customer that they do not state requirements overtly. When these requirements are met, the customer says nothing, and probably does not even notice. When these features or services are not present, the customer puts up complaint. Continually improving on meeting these kinds of needs will not elicit customer loyalty or delight.

Normal Requirement

Sometimes referred to as "fundamental" quality. Customers overtly state these needs and are quite cognizant of them. When these needs are met, customers are satisfied, when they are not met, customers are dissatisfied. For many types of requirements in this category, it is possible to deliver more than customer requirements and generate additional perceived benefit.

Delightful Requirement

Customers have needs that they are not aware of. These are referred to as "latent" needs. They are real, but not yet in the customer's awareness. If these needs are not met by a provider, there is no customer response. They are not dissatisfied, because the need is unknown to them. If a provider understands such a need and fulfils it, the customer is rapidly delighted.

A company needs to discriminate between these types of needs in order to offer successful products and services and to avoid risks associated with having a weakness on one type of quality that detracts from a strength in another.

Customer Satisfaction Index (CSI)

Customer Satisfaction Index is a means of measuring customer (External as well as Internal) satisfaction. Data for CSI is collected through a survey by the means of a questionnaire or other. The index monitors a number of different areas that are all combined into the final calculations to present a single indicator. It is this single indicator that represents a particular score of Product/Service/Unit, and the facet that makes comparison easy. In the measurement process a number of different components of customer satisfaction are measured and are each analysed to provide the total picture. The components that are used in the measurement process vary from Product to Product/ Service to Service/ Unit to Unit.

For calculating CSI of External Customer, some of the attributes used are:

- Perceived Quality
- Customer Expectation

- Perceived Image
- Perceived Value
- Customer Satisfaction
- Customer Loyalty

Some common attributes for measuring CSI for Internal Customers:

- Communication
- Involvement
- Response Time
- Customer Friendly Attitude
- Innovative Approach
- Training and Guidance
- Problem Solving at Lower Level
- Quality of Service

In addition to above, organisations periodically assess the satisfaction level of employees (who are internal customers) based on several attributes such as Career Prospects, Safe Work Environment, Welfare Facilities, Concern, Opportunities for Learning etc. The periodic measures provide rich input to organisations to analyse and evolve a plan of actions to achieve further improvements.

The *Cost of a CSI* for an organisation depend on the size of survey, the method of data collection (postal, telephone, interviews), the extent of any modifications or additions to the questionnaire and the development of a customer database (if needed).

3.3.7 LIAISON, TEAM FORCE AND SKILL DEVELOPMENT

Liaison

Liaison is co-ordination/communication between two entities, leading to partnership for mutual benefits. Liaison may be between employer, employees, suppliers, customers, other stakeholders (shareholders, society, govt. agencies etc.).

Liaison needs proper planning to achieve the satisfaction of the customer. Liaison and understanding are very essential. The need for liaison and understanding is to meet the demands of the market place.

The purpose of liaison in a manufacturing company is to communicate priorities regarding

what work should be done and when it should be performed. Properly executed liaison provides the vital link between managerial plans and the efficient use of manufacturing resources. This fulfils a fundamental business goal supplying customers with what they want, and when they want it.

Good liaison and understanding leads to a number of beneficial business outcomes such as:

- Better marketing, financial and operations information
- Increased customer service
- Increased manufacturing and operating efficiency
- Better allocation of scarce resources
- Elimination of wasted finished goods, work-in-process and raw materials
- More flexibility to respond to customer preferences
- Increased profitability and return on investment

Team Force

Typically, people work in small groups that have common or related functions. Each person in such a group has an individual aspiration, level of skill, and attitude towards the task. Since people think, feel and respond according to their individuality; they sometimes do not consider the benefits of supporting and co-operating with others to achieve a common goal. Ultimately the group will not have much success until they are motivated to work toward a common goal. A skilled coach will be able to pool their talent and train them to play together compensating for individual strengths and weaknesses.

The various stages of Team Force are:

- Formation and Stabilisation

Forming ⟶ Storming ⟶ Norming ⟶ Performing

- Being self directed in activities – Self directed teams.
- Being self-employed – Self empowered teams.

Characteristics of an Effective Team:

- Members recognise their interdependence and understand both personal and team goals are best accomplished with mutual support. Time is not wasted struggling over *'turf'* or

attempting personal gain at the expense of others.

- Members feel a sense of ownership for their jobs and unit because they are committed to goals they helped to establish.
- Members contribute to the organisation's success by applying their unique talent and knowledge to team objectives.
- Members work in a climate of trust and are encouraged to openly express ideas, opinions, disagreements and feelings. Questions are welcome.
- Members practice open and honest communication. They make an effort to understand each other's point of view.
- Members are encouraged to develop skills and apply what they learn on the job. They receive the support of the team.
- Members recognise that conflict is a normal aspect of human interaction but they view such situations as an opportunity for new ideas and creativity. They work to resolve conflict quickly and constructively.
- Members participate in decisions affecting the team but understand that their leader must make a final ruling whenever the team cannot decide, or when an emergency exists. Positive results, not conformity is the goal.

Skill Development:

"Skills generally refer to capability to do one's job. These skills are the ability to act accurately and reflexively (without considering) in response to any phenomenon, based on acquired knowledge and experience, and to sustain that action for a long time," (Refer book: Shirose Kunio (1996), *TPM (Total Productive Maintenance) – New Implementation Program in Fabrication and Assembly Industries, Japan Institute of Plant Maintenance (JIPM),* Tokyo.)

All types of jobs even the simplest one, requires some training for efficient performance. Training is the process of increasing the skill and knowledge of personnel for the purpose of improving individual and organisational performance.

Methodology for Skill Development:

Before starting training for skill development, evaluation of the present status is done in the following four categories and training program is prepared accordingly:

A	Do not know the subject
B	Know the subject but can not do the job
C	Know the subject and can do the job
D	Can do as well as can teach

Table 3.6: Skill Development Methodology

Skill Development Training:

1. Identification of Existing Knowledge & Skill
2. Identify Training Needs
3. Preparation of Training Program
4. Conducting Training as per Program
5. Conducting the Test & Evaluation
5. Re-training
6. Re-evaluation
7. Continuous Process till the Employee is fully trained and can teach others

3.3.8 INFORMATION, SYSTEMS, TECHNOLOGY, CASH FLOWS AND WORLD CLASS OFFICE MANAGEMENT (WCOM)

Information

Data and Information is considered to be one of the important resources of the business today. Information Technology is growing at an exploding speed.

"The information age is also characterised by the emergence of information or post which is dominated by knowledge workers – those working with information rather than producing goods." (Refer book: Bell, D. (1973), *The Coming of Post – Industrial Society: A Venture in Social Forecasting*, Basic Books, New York.)

"The emergence of the information era in the last decades of the twentieth century made many of the fundamental assumptions of the industrial age competition obsolete. Consequently, companies could no longer gain sustainable competitive advantage by merely deploying new technology into physical assets rapidly. The information age requires new capabilities in organisations for competitive success." (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

In the last decades ERP, SAP and other entrepreneur resource management tools are

integrated into the business flow, through which the processes, their performances and business as a whole can be monitored.

In order to remain the best in this competitive World, information about various sources are must. Information not only about Customers & Market but also about the Vendors, Competitors, Employees is required and that too about Present as well as Potential.

"In the information age, product life cycles continue to shrink. Competitive advantage in one generation of a product's life, is no guarantee of product leadership in the next technological platform." (Refer book: Kaplan, R.S. and Norton, D.P. (1996), *The Balanced Scorecard: Translating Strategy into Action*, Harvard Business School Press, Boston, Massachusetts.)

As modern organisations grow more complex, information handling surprisingly goes up all the way. There is a growing sophistication of technology in industries, and physical involvement with primitive technologies is becoming less and less important.

(Refer CD-1, Exhibit-3.6, Power point Slides of Indo Thai Synthetics on Information and Systems, **Exhibit-3.7,** Energy Centre Report of Birla Cellulosic)

System

Large organisations are systems comprising of various departments as sub systems and departments comprising of sections and sub sections. The integration of all these systems and sub-systems makes the organisation a system and a single unit.

The Aims of Systems are to:

- Develop Systems that are easy to understand and user friendly.
- Remove bottlenecks from the existing Systems
- Maximise the effectiveness of the System

The Systems/Sub-Systems often get sluggish due to Non Value Adding activities. Process Mapping is a proven approach to identify the sequence of all activities. Application of Business Process Re-Engineering (BPR) helps in streamlining the Systems by eliminating avoidable workstations etc. thus providing speed and responsiveness.

"Until a few years ago, ERP systems were touted as the hot new mantras for managing change. The conventional wisdom now is that they are necessary but not sufficient for survival in today's competitive markets. Supply Chain Management (SCM) solutions are the 'new kids on the block' in terms of IT (Information Technology) solutions for manufacturing. These solutions operate on data generated by ERP systems (or reliable legacy systems) and have built-in real time optimising capabilities." (Refer book: Sahay B S, Saxena K B C, Kumar

Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

(Refer CD-1, Exhibit-3.8, Process Mapping Example)

In order to make the best utilisation of the available resources, attention to every detail must be given before adopting any system.

Technology

This focus area aims at continuous up gradation of Technology in order to achieve consistent results and remain competitive in the global market. All the relevant information about the latest inventions and discoveries in the field of Process and Product development is required to be updated on a regular basis.

"Technology does not work in isolation. Not only can technology be separated from the activities that surround it, but also *a* technology cannot be separated from other technologies." (Refer book: Iansiti, Marco. (1998), *Technology Integration – making critical choices in a dynamic world*, Harvard Business School Press, Boston, Massachusetts.)

The following are the essential features of Technology Development:

- Continuously seek information about new/emerging and alternative Technologies
- Evaluate and prepare implementation plans
- Facilitate smooth Technology Absorption
- Monitor impact of Technology

The scope covers Products, Process, Equipment, Systems etc.

Cash Flows

Managing for cash flow is managing for survival. Manage cash flow effectively and the business works properly. Always look for and ensure that:-

- Costs are in order
- Sales and collections efforts work together
- Margins are protected
- Market share grows
- Profits increase

Following four are the major causes of cash flow Problems:-

- Fixed costs creep upwards

- Variable costs slip out of control
- Sales don't turn into cash fast enough
- Inventory becomes bloated

There are other causes - but these are the main profit killers.

WORLD CLASS OFFICE MANAGEMENT (WCOM)

WCOM is the generic name given for Office Management Technique. It aims at creating an environment/culture in the Office which:

- Enhances Productivity
- Eliminates all forms of wastes
- Makes the Workplace more user friendly
- Makes the process more transparent
- Pays attention to details
- Is Self Sufficient & Wins Customer Confidence
- Creates an outstanding Corporate image
- Responds quickly to the rapidly changing social and business environment

Some of the important elements of WCOM are:

- Office Organisation
- Office Administration
- Office Environment
- Office Machines and Equipment: Self-Maintenance
- Office Communication & Correspondence
- Visual Management and Control

3.4 WCM METHODOLOGY

WCM follows a specific methodology to make the organisation competitive for facing the challenges of tomorrow and for achieving the end results.

It broadly includes three steps:

1. Forming the Teams
2. Equipping the Teams, and
3. Visual Competition amongst the Teams

3.4.1. Step One: Forming the Teams

The whole business is divided into small, overlapping, cross-functional, multi-skilled, self-competing high performance teams covering all areas, all employees and all equipment. These Operating teams assume ownership of their areas and define their internal customers. The QCDIP requirements are identified. To develop the ability to deliver the desired QCDIP performance, the teams focus on the Eight Dimensions. For specific improvement, Project teams are also formed. These Project teams comprise specialists from different functions.

The Objective of Team Formation is to; involve each and every employee of the company , work as a team and develop a sense of belongingness

All the employees are included in overlapping structure and **all the areas** are covered. The Teams are basically cross - functional in nature and the members are right from the grass-root level. The entire factory floor is broadly divided into zones, which may be done on the lines of departments or functions. Each zone has a leader, who can be the departmental head or senior most executive of the zone. The Zone is then divided into multi-skilled teams at various levels.

Level-1 is represented by front-line workmen, with foremen/jobber as team-member.

Level-2 team consists of shift supervisor, shift in-charge, maintenance staff and workers and the foreman/jobber would also be part of this team.

Level –3 team consists of the shift in-charge and general shift staff who reports to head of the department.

The teams are self-competing. At level-1, teams compete for quality and equipment effectiveness for the machines in their control, at level–2 competitions between shifts, and at level–3 it is comparison with other departments. The nature of this competition is a very healthy one. This competition acts as a driving force for sustaining the momentum for continuous and sustained improvement. In other words the employees work together in a team and the teams compete with each other in a positive way.

Each team has an identity; each member has a sense of belongingness to a team. Each team is given a number.

Example: *First two digits may be for the zone say zone number is 04

*Next digit may be for the level of the team in the zone say level number is 2

* Fourth digit may represent the shift (alphabet) say shift is A

*Last digit may represents the sequence number of the team in that level and zone say is 3.

Then team number would be 042A3

(The example of Team Formation from one of group unit (PT Indo Liberty) has been given under Implementation on pages 122-124.)

The hierarchy of Team Formation is generally as follows:-

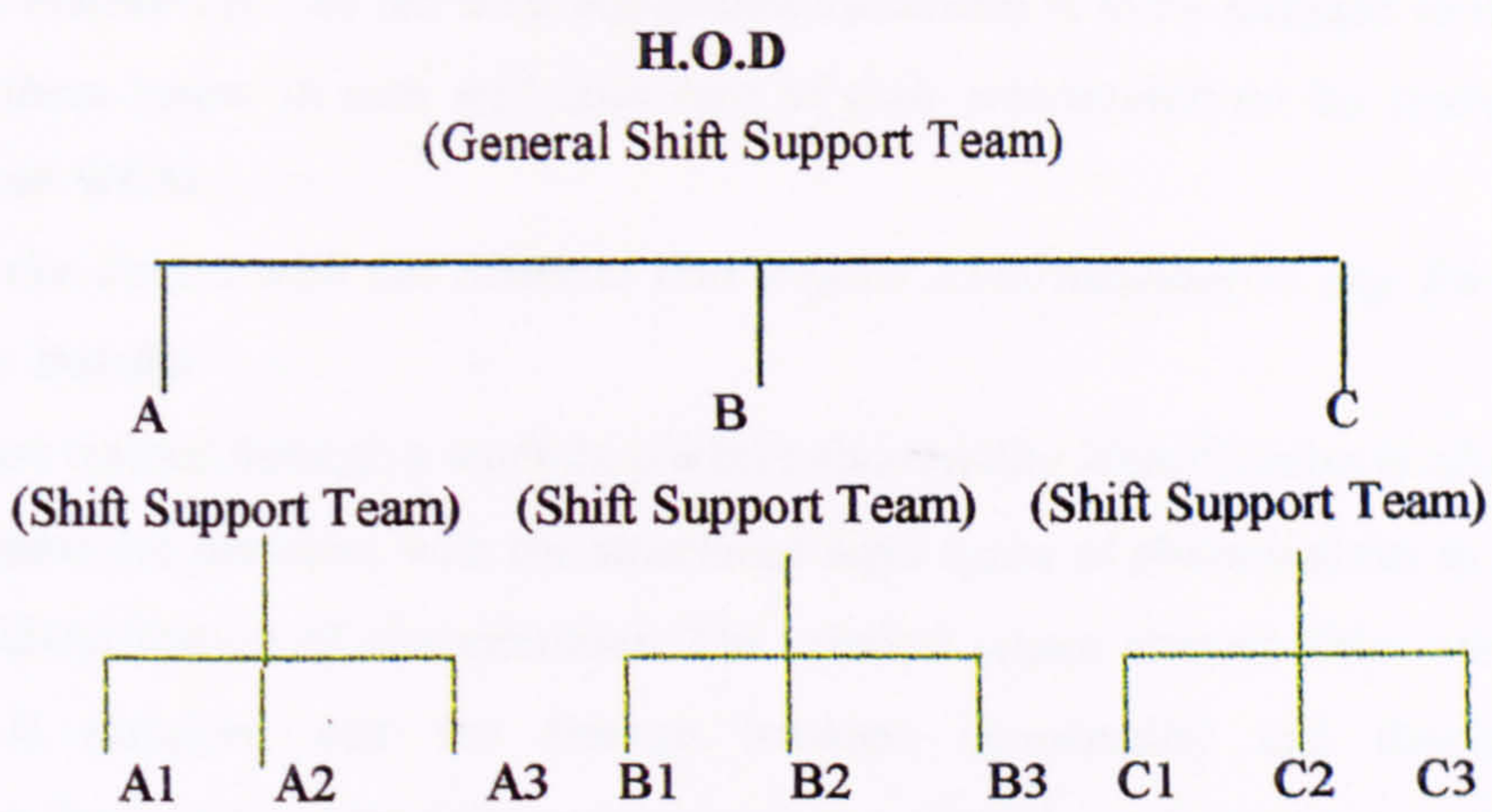


Fig 3.9: Hierarchy of Team Formation

Teams aim for cent per cent marks for QCDIP parameters (The *QCDIP parameters are specific for any Organisation*-**(Refer CD-1, Exhibit-3.9A,** QCDIP parameters, Indal Hirakud Power)

3.4.2 Step Two: Equipping the Teams

Once the teams are formed these are equipped with Mindset, Weapons and Tools & Techniques of WCM for eliminating the root cause of all deviations from standards. They are also educated and trained on the rules of the game, in the form of values and mindset for excellence. Specialised workshops are conducted for specific weapons, such as JIT, SPC, PM Analysis, and other advanced problem solving tools. Such type of training is imparted and facilitated by the concerned Corporate Facilitator through the Unit WCM Secretariat. The duration of such specialised workshops varies between 2-5 days. Many of the workshops require revisits, as they have to be conducted in more than one phase. Moreover, many of

these workshops result in the initiation of many projects whose successful completion requires further training. Also the initiation of a particular phase requires successful completion of specified tasks after the completion of training in the preceding phase. *For example the Six Sigma training module is done in four phases i.e. Define & Measure, Analyse, Improve and Control with a week's gap between each phase.*

Establishing Ownership:

The teams are expected to work on the principle of "This is our area and our equipment and we together maintain it". So the area/ equipment ownership is to be assigned to the respective teams and these teams in turn will take care of their area/equipment by practicing all the dimensions of WCM.

Equipping the Teams with the Mindset that Rejects Abnormalities in any Form and Pays Attention to Details:

The teams are trained through a workshop where abnormality identification is taken as the key task. The teams are provided with the structured eight types of abnormalities to facilitate the process of identification of abnormalities. The mindset where abnormalities are accepted as inevitable is scrapped and the linkage between abnormality and forced/accelerated deterioration leading to early failures/accidents etc. (which push up cost and lower down quality) is made clear to every employee.

Train the Teams on 5 Why's (Why-Why Analysis), 7QC Tools, PM Analysis, PDCA, IE Techniques, Value Engineering, and FMEA:

The training is imparted to team leaders to begin with who in turn should train the members. Each tool is explained with examples and participants are asked to use each tool in the training program to obtain deep understanding. Thereafter the teams use the tools in Problem solving in their ownership areas. .

Train the Trainers/Team Leaders on Leadership & Communication Skills:

Units train the Trainers and Team Leaders under the facilitation and guidance of Corporate Facilitators on Leadership and Communication Skills because the success of teams is very much dependent on these Trainers and Team Leaders who are responsible to lead and train all the employees/ team members through relay training. These trainings are imparted just after the First Conference cum Workshop through specialised workshops in the same manner as referred earlier in the same chapter. One may be successful as an individual but may not be as a leader. The key impediments are generally a lot of resistance to change from the Middle Management. The other form of resistance arises as a result of existing traditional hierarchies

whereas the philosophy of WCM is totally a Team-based Organisational Structure that is in direct conflict with the traditional hierarchies. Initiation of WCM Campaigns by all the teams in all the Areas:

The Organisation launches the following Campaigns in all the areas:

Know Your Equipment

Initial Cleaning

Why-Why Analysis

Visual Controls

Simplify the Systems

Standardisation of Lubricants

Internal Warranty Systems

Halve Your Losses/ Defects

Double the Productivity

Reduce Working Capital

The above campaigns are displayed and followed by all the teams.

Setting Mission Statement for all the teams:

A mission statement elaborates why you are in that business. For a team the mission statement can be '*to produce the product within the specified limit and deliver it to the internal customer on time in full*'. Every team prepares a mission statement in which it outlines in brief what it strives to achieve within a given frame. The Mission should be in line with the Vision of the organisation. This results in a creation of a *Lean Deployment Structure* in line with the Business Objectives.

Setting QCDIP of all the teams:

Every team plays a triple role – Customer, Processor and Supplier. The QCDIP is very important for all the teams. The QCDIP is based on the Customer expectations and is prepared in consultation with them. The QCDIP is measurable and is monitored to achieve targets set.

An example from PT Indo Liberty given in ongoing pages under the head-'Implementation'

Top Management Leading by Setting Examples:

The Abnormality Free Proactive Culture cannot be achieved unless the Leadership is effective. The Top Management understands the WCM Concept and practices it. The Leaders set examples for the others. Visible Commitment on day-to-day basis from the Leaders is an important aspect. Involvement of the Top Management in the Initial Cleaning, Abnormality Identification exercise etc. has shown a positive result. The Top Management regularly

interacts with the Sub-Committees and WCM Secretariat. During the Steering Committee meetings the Top Management reviews the progress. They also conduct Autonomous Maintenance in their own area, practice ZAM (Zero Abnormality Movement), Use Problem Solving Tools, understand the concept of Internal Customer, encourage Quality awareness etc. For example in one of the Fertilizers and Chemical units, every day from 1600 Hrs to 1700 Hrs Cross-functional Team visits one the designated areas to conduct Autonomous Maintenance exercise. In this exercise the team identifies and rectifies abnormalities, conducts a Root Cause Analysis of the problem at the site itself.

3.4.3 TOOLS AND TECHNIQUES OF WCM

WCM equips employees with the ability to diagnose & rectify the problems autonomously.

"In terms of quality, the WCM approach emphasises on the resolution of the problems that cause poor quality, rather than mere detection of those problems. The purpose is to systematically expose and resolve the root causes of quality problems so that the company can ideally achieve zero defects or 100 per cent quality." (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

The most widely used proven tools/techniques and approaches in the armoury of war against competition are given below:

Visual Management & Controls

Time Management

Problem Solving Tools, such as:

- Why – Why Analysis
- PM Analysis
- Brain storming
- Cause & Effect Analysis
- FMEA (Failure Mode Effect Analysis)
- PDCA Cycle
- Flow Diagram
- Value Engineering

SMED (Single Minute Exchange of Dies)/ QCO (Quick Change Over)

Benchmarking

One Point Lesson

Zero Abnormality Movement (ZAM)

Multi-Skilling

3.4.3 (a) VISUAL MANAGEMENT & VISUAL CONTROL

Visual Management: –

Visual Management is a means of Managing the Workplace/Process through Visuals. It can also be termed as management by visibility or management by sight. Visual Management creates awareness and generates alarm before errors are generated. It introduces transparency in the process/operations. This is also used for communication and alignment of employees.

The benefits *of Visual Management techniques are:*

- Increased ease of operation and inspection
- Reduced inspection time
- Abnormalities show up and are easily noticeable
- Less chances for operation and inspection of errors
- Improved safety Increased awareness of activities
- Reduced cost

Some Examples of Visual Management:

Plant Board at the entrance of the Plant:

To proliferate the WCM Culture throughout the organisation, the most important step is to display a set of three boards containing the following information:

- Eight Types of Abnormalities
- Eight Dimensions of WCM
- Plant layout indicating the WCM Zones & Chairman's Message

The eight types of abnormalities are displayed in English, Hindi and the local language. It helps in creating an Abnormality Free Culture. The Eight Dimensions are also displayed with a short note on each Dimension. The entire Plant is divided into zones and the zones are divided into Team Areas. These zones are shown in different colours on the Plant Layout Board. The name of the owner (Team Leader) of each zone is indicated in the layout along with his/ her telephone number. The Message of the Chairman clearly indicates the Vision of the Company and helps the employees to align their goals with that of the Group.

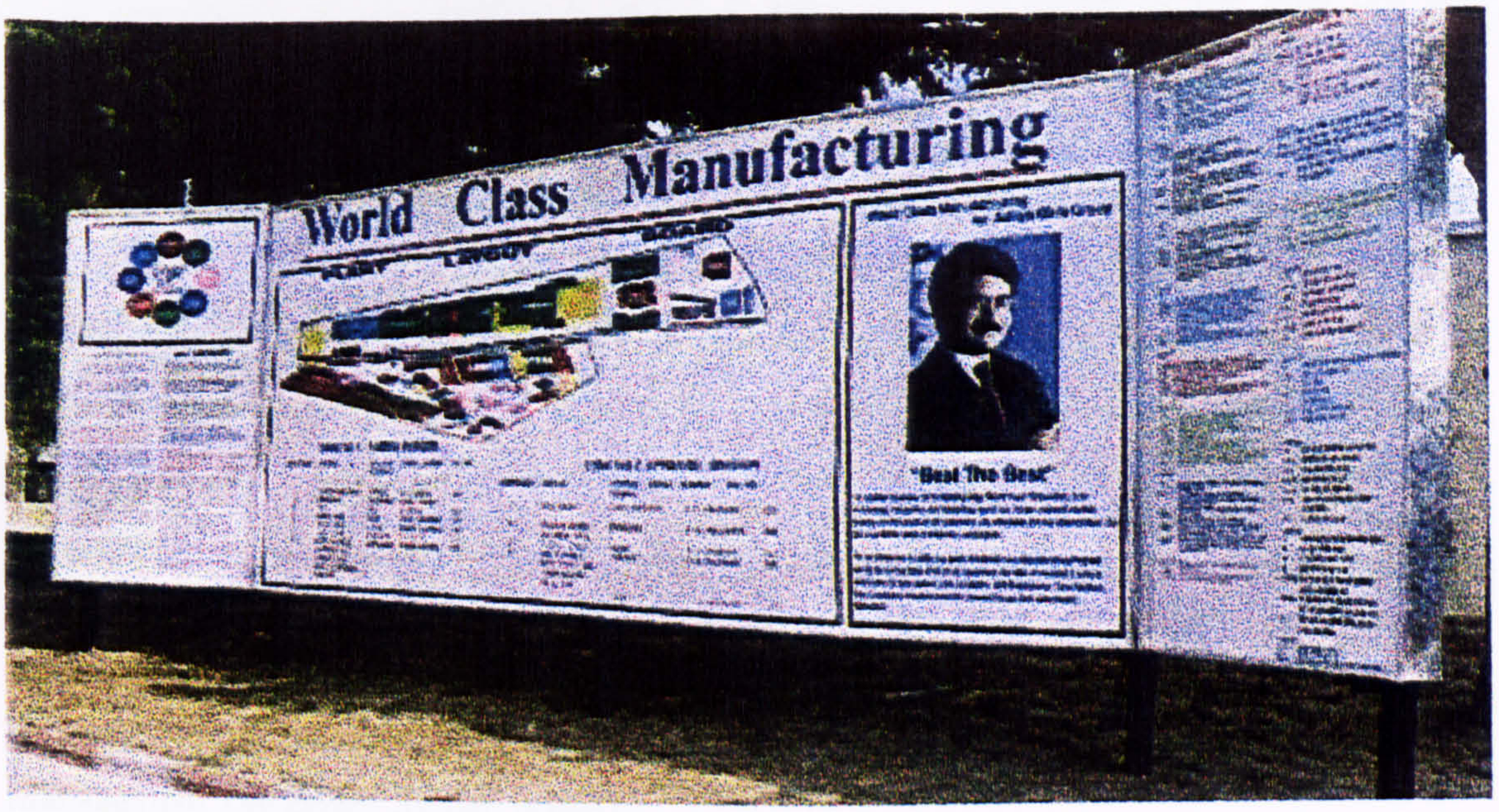


Fig 3.10: Plant Board

Zone Boards

The entire Plant is divided into zones, and these zones are further required to be divided into Team Areas. At the entrance of each zone a Zone Board indicating the Team Ownership Area and overall performances are displayed.

Process Performance Board

There is usually one Process Performance Board for each Operating Area Teams with assigned area of responsibilities. It is the responsibility of the Unit WCM Cell to modify the Guidance notes to suit Plant's specific requirements.

This Board displays the achievements on the following indicators of the Area/Teams:

- Waste Elimination Status
- Work Environment (5S) Status
- JIT & Stock Reductions
- Overall Equipment Effectiveness
- Abnormality Removal Status
- Hours spent on Brain storming, Problem solving, and New Skill Development
- Number of Innovations

QCDIP Board

This Board is displayed at Zone Level. The Board displays the over all achievements of the

Zone irrespective of the number of teams in the zone. The leader of the zone has the responsibility of updating the board on a monthly basis.

. *"You can't tell the winners without a scoreboard, or tell the losers either. And without a scoreboard neither winners nor losers will know which they are."* (Refer book: Creech Bill (1994), *The Five Pillars of TQM – How to Make Total Quality Management Work For You*, TRUMAN TALLEY BOOKS? PLUME Penguin Group, New York.)

"Only the poor performer doesn't want to be measured." (Refer book: Harrington H James, Lomax Kenneth C (1999), *Performance Improvement Methods-Fighting the War on Waste*, McGraw-Hill, New York.)

Abnormality Management Tag Board

In order to make the Abnormality Management process transparent, Abnormality Management Tag Board System is used.

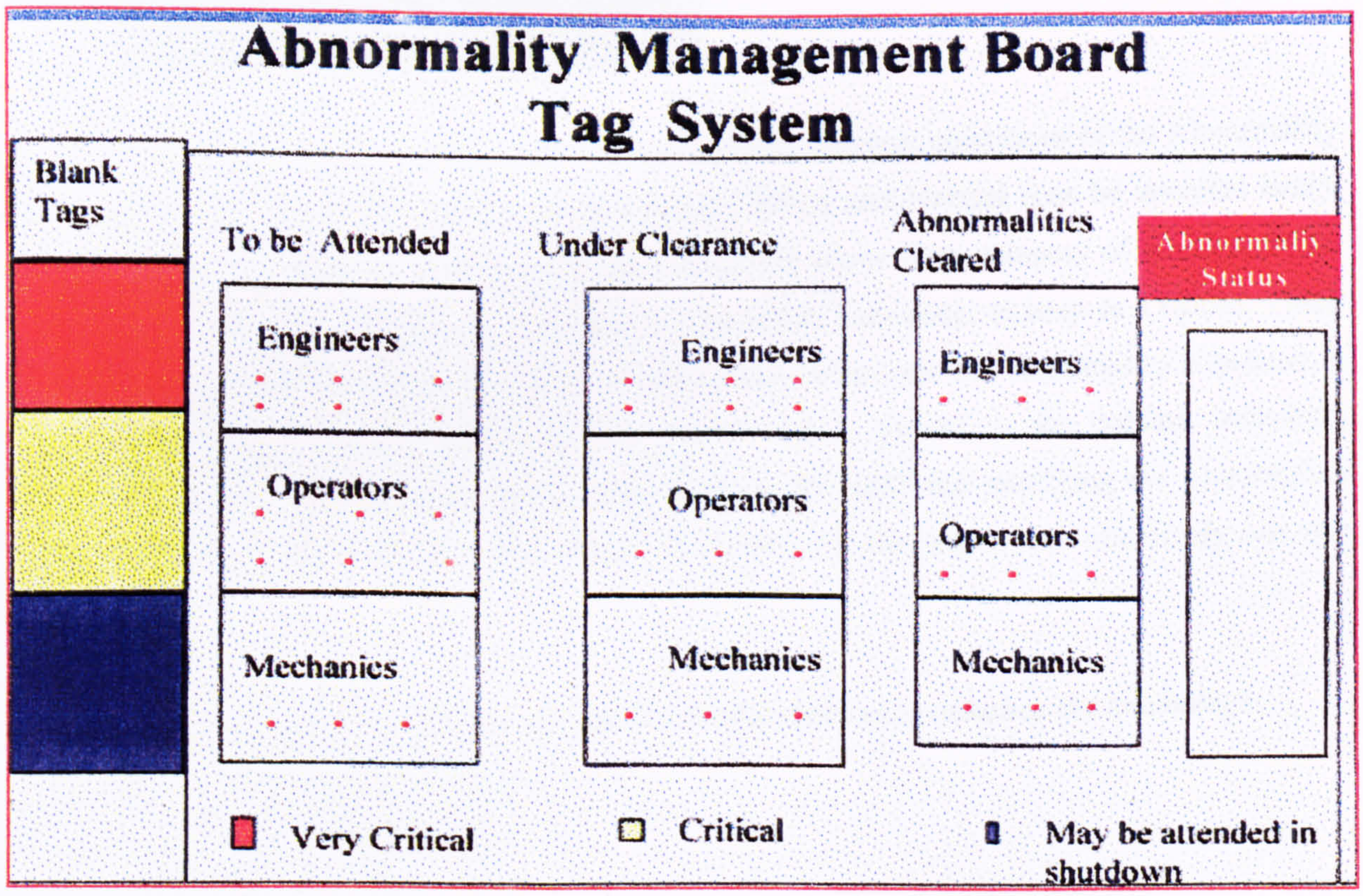


Fig. 3.11 : Abnormality Management Tag Board

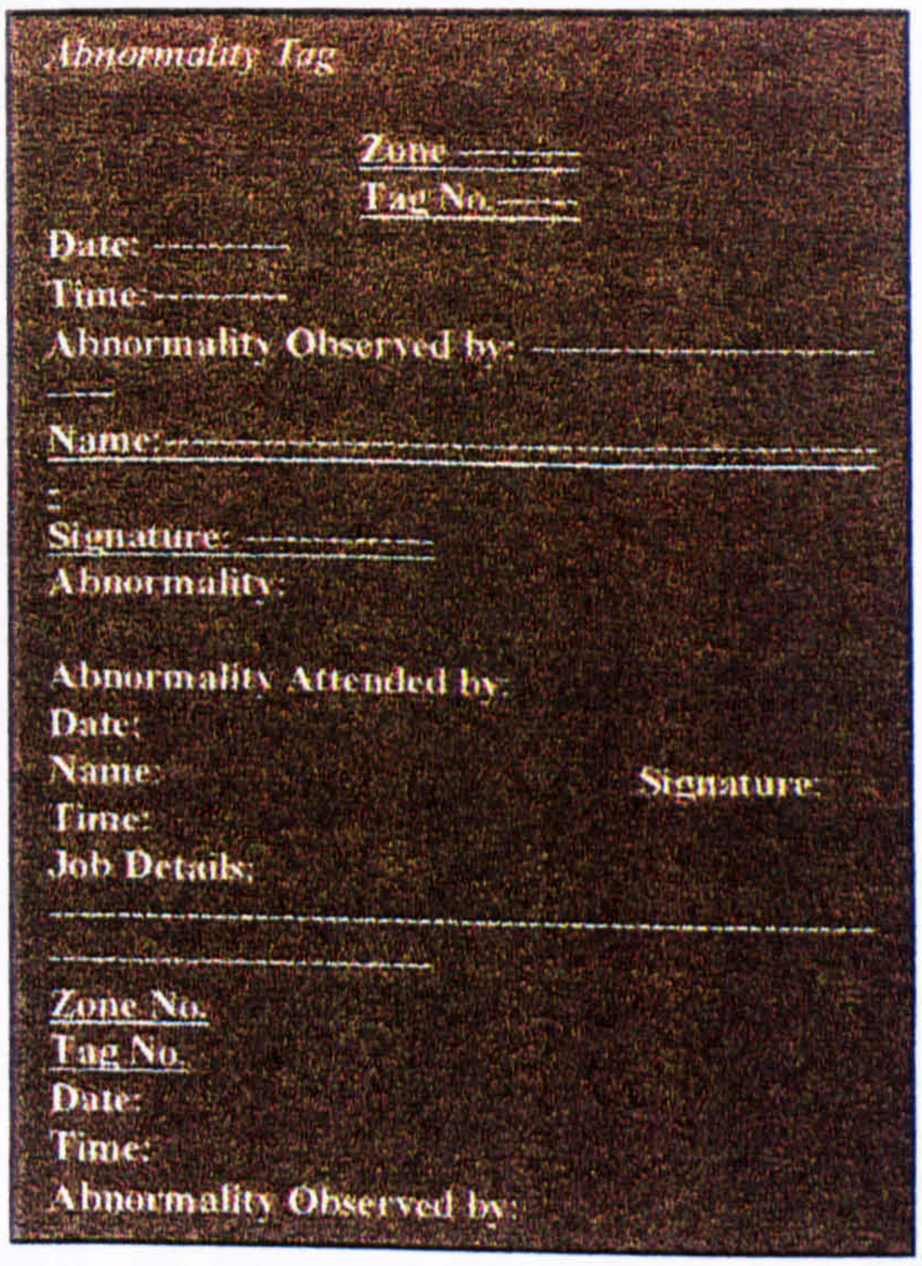


Fig 3.12: Abnormality Management Tag (AMT)

The Tag Board contains three colours indicating three different conditions of the Abnormality i.e. Very Critical (to be attended immediately), Critical and Normal (can be attended later). The Tags are also made in three different colours for above three category of Abnormalities. The lower end of the Tags are perforated for the WCM Secretariat to keep as a record. These Tags are placed on Tag Board at a appropriate place. Whenever any abnormality is noticed, it is written on the tag available on the Board and is placed in the column indicating responsibility. The concerned person after noticing the AMT and rectifying the Abnormality can place the tag in the column named "cleared". All the employees effectively use this system.

The *following* ***information*** are displayed on the ***Equipment to enhance the knowledge***:

- SOP/Compliance Confirmation
- Cleaning/Inspection Standards
- Lubrication Standards
- One Point Lessons
- Know Your Equipment
- Trouble Shooting
- Equipment History Card

Visual Controls:

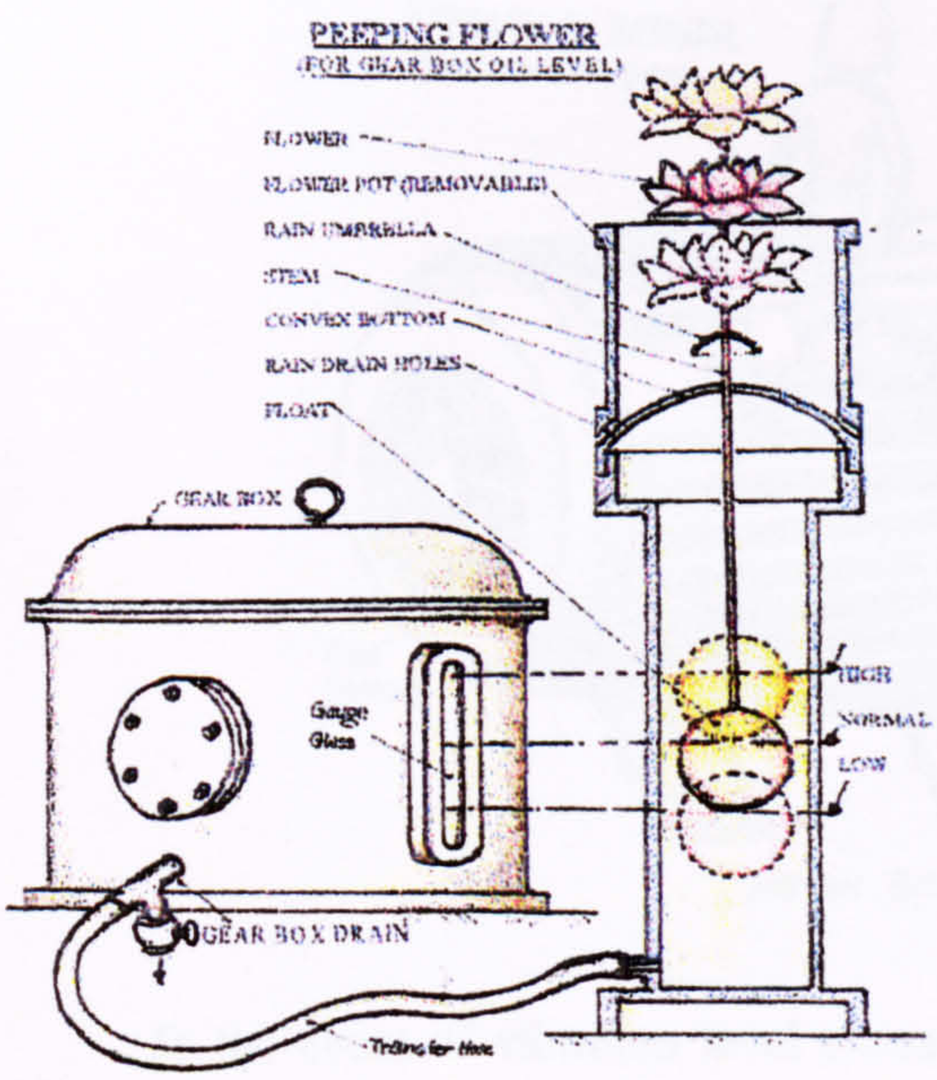
Visual Controls enable the abnormalities to show up themselves.

Some Examples of Visual Controls:-

- Indication of Lubricant Level
- Markings on Floor
- Level Indicator for Tanker/ Wagons
- Running Motor Indicators
- Thermal Paints
- Visual Control for Threshold Vibrations

Visual Control for Levels:

The Oil Level of Gear box is transferred through proper tubing to another pot, which is provided with a float attached to a brilliant colour object (Plastic flower or doll). The top of the pot is specifically designed to hide the visible object when level falls below normal. Similarly, for increasing the visibility of a hidden/obstructed level a float with prominent visible object like plastic flower/doll etc can be improvised to float upright and indicate the level from a far distance. Following example are some practical examples being deployed in many group units.



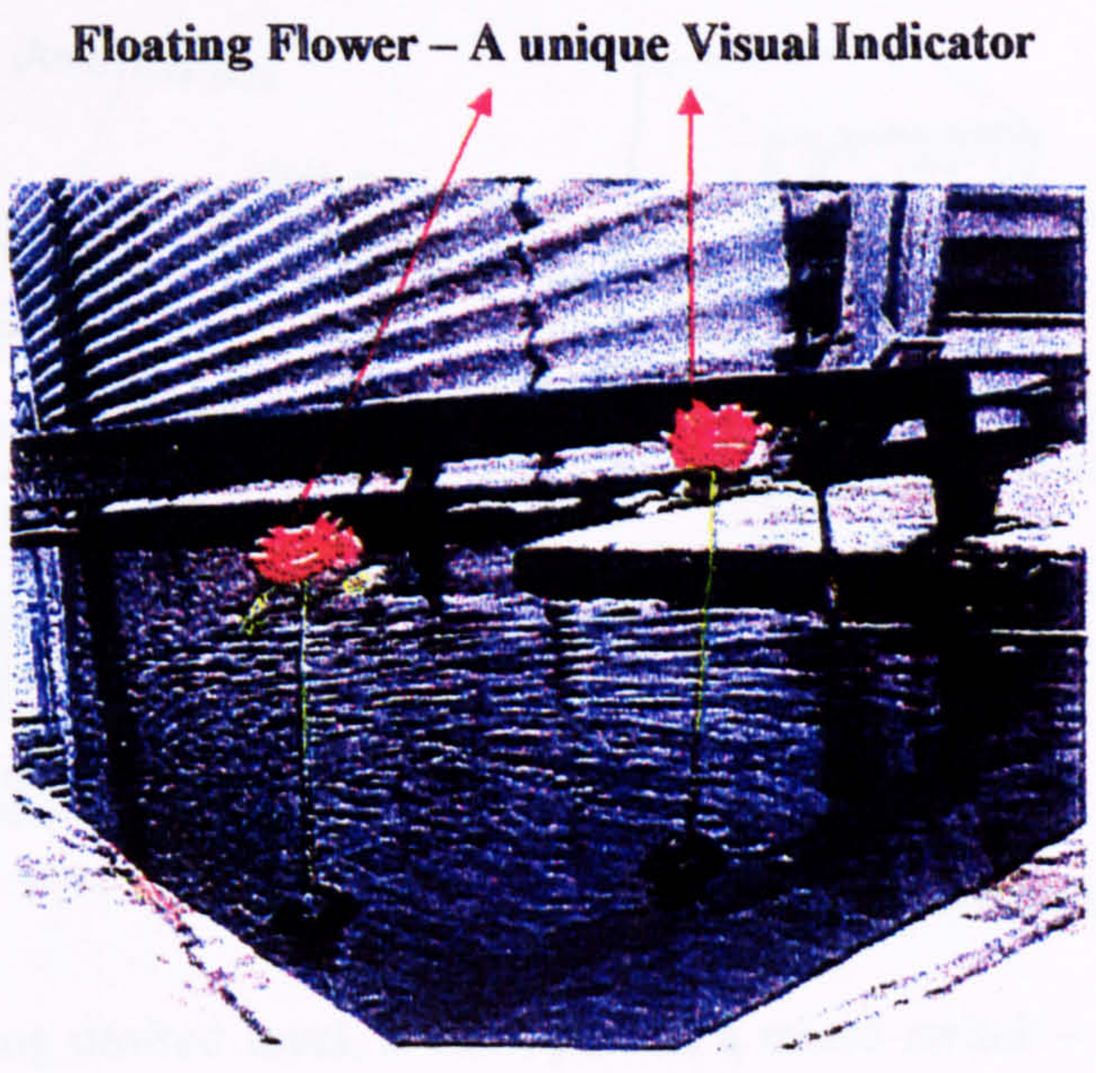


Fig 3.13(a) & (b) Level Indicator for Gear Box oil and a Open Pond

Visual Indicator for Over Heating:

Thermal Paint has the property to change its colour automatically at higher temperature. The Operators and Electricians should be trained to notice the variation in the temperature. For detecting Overheating in a motor, Thermal paint can be applied on the drive end and the non-drive end of the casing leaving out the fins.

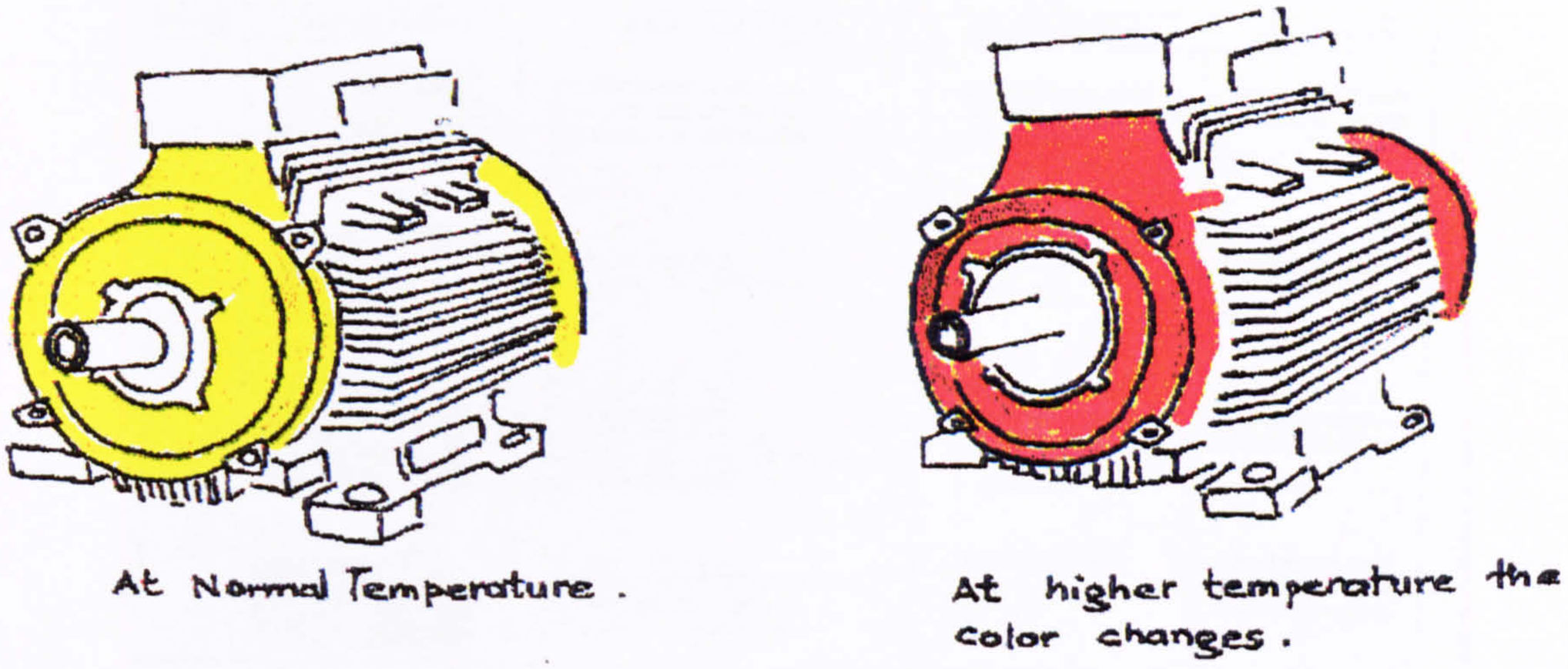


Fig 3.14 a & b: Over Heating Indicator

Example of Visual Indicator for Vibration: Audio Visual Alarm (Hooter)

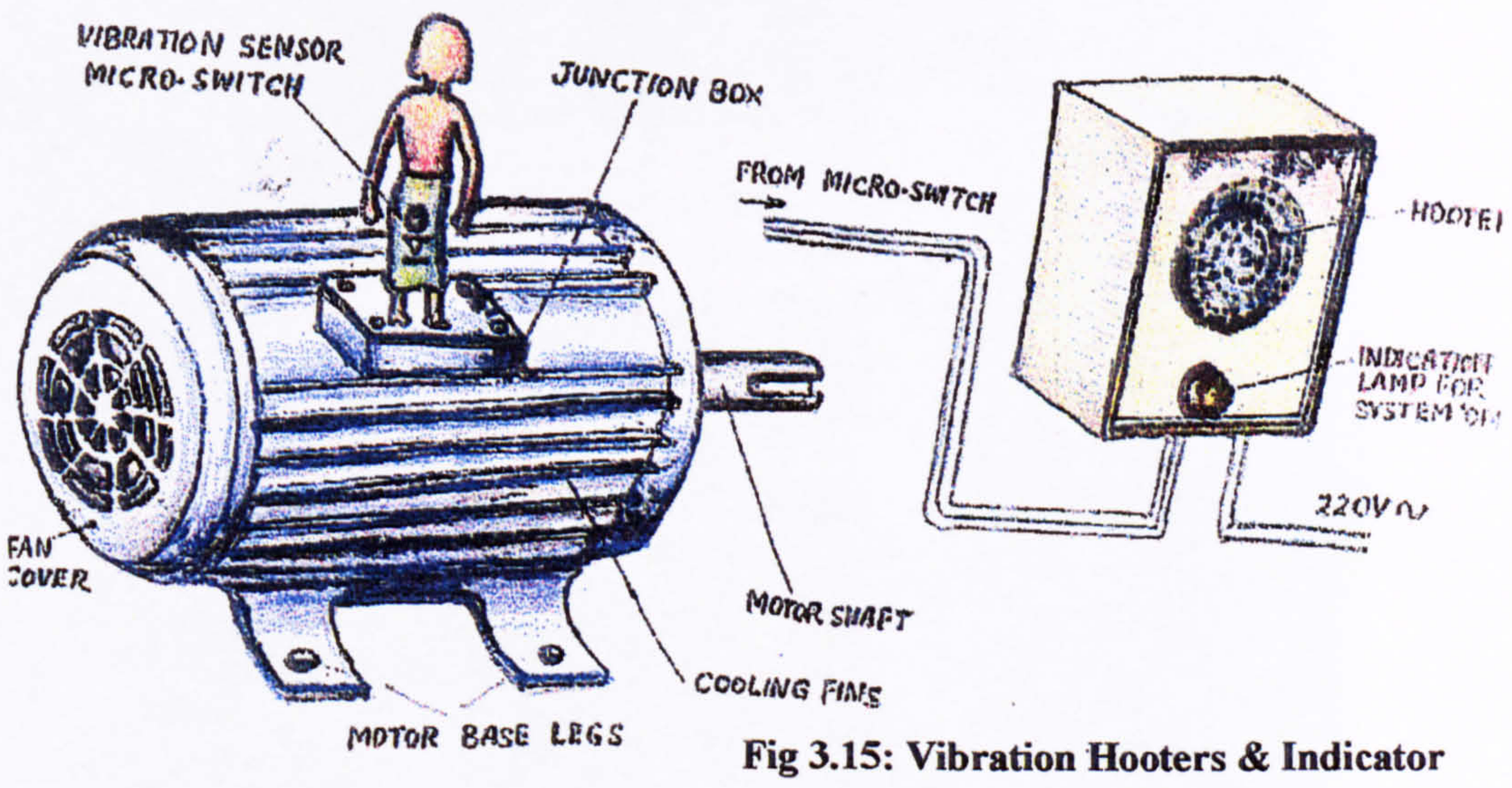


Fig 3.15: Vibration Hooters & Indicator

In the event of vibration level exceeding desired level, a ball operates a micro switch – post sensor mounted on machine. This switch operates an indication lamp. If connected with hooters a sound alarm also can be created.

Visual Indicators on Equipment:

A Colour code is assigned to each Lubricant. To make it more effective, the lubrication inlet of the equipment is also marked with the same colour. The containers and funnels are also marked with the respective colour code to prevent any mistake while lubricating.

WORLD CLASS MANUFACTURING
By Aditya Birla Group

Unit : WCM Cell
Harihar Polyfibers

Sl. No.	DEPARTMENT	LUBRICANT USED	COLOR CODE	INDICATOR
1.		HYSPIN AWH 46. OIL HYSPIN AWS 100 OIL LITHON - 2 GREASE	BLUE/YELLOW PURPLE/YELLOW YELLOW	
2.		ENKLO 320 OIL LITHON - 2 GREASE	SKY BLUE YELLOW	
3.		ENKLO 68 OIL ENKLO 460 OIL SERVO FRIZ 46 OIL SERVO GEM HT XX GREASE BR - 3 GREASE	GREEN/GRAY NAVY BLUE ORANGE RED P-GREEN	
4.		ENKLO 68 OIL SERVO MESH SP 320 OIL SERVO COAT 120 OIL LITHON - 2 GREASE	GREEN/GRAY PURPLE BLACK YELLOW	

Fig 3.16: Colour Codes Display for Lubricants

Fig 3.17: Colour Code Application for Lubrication

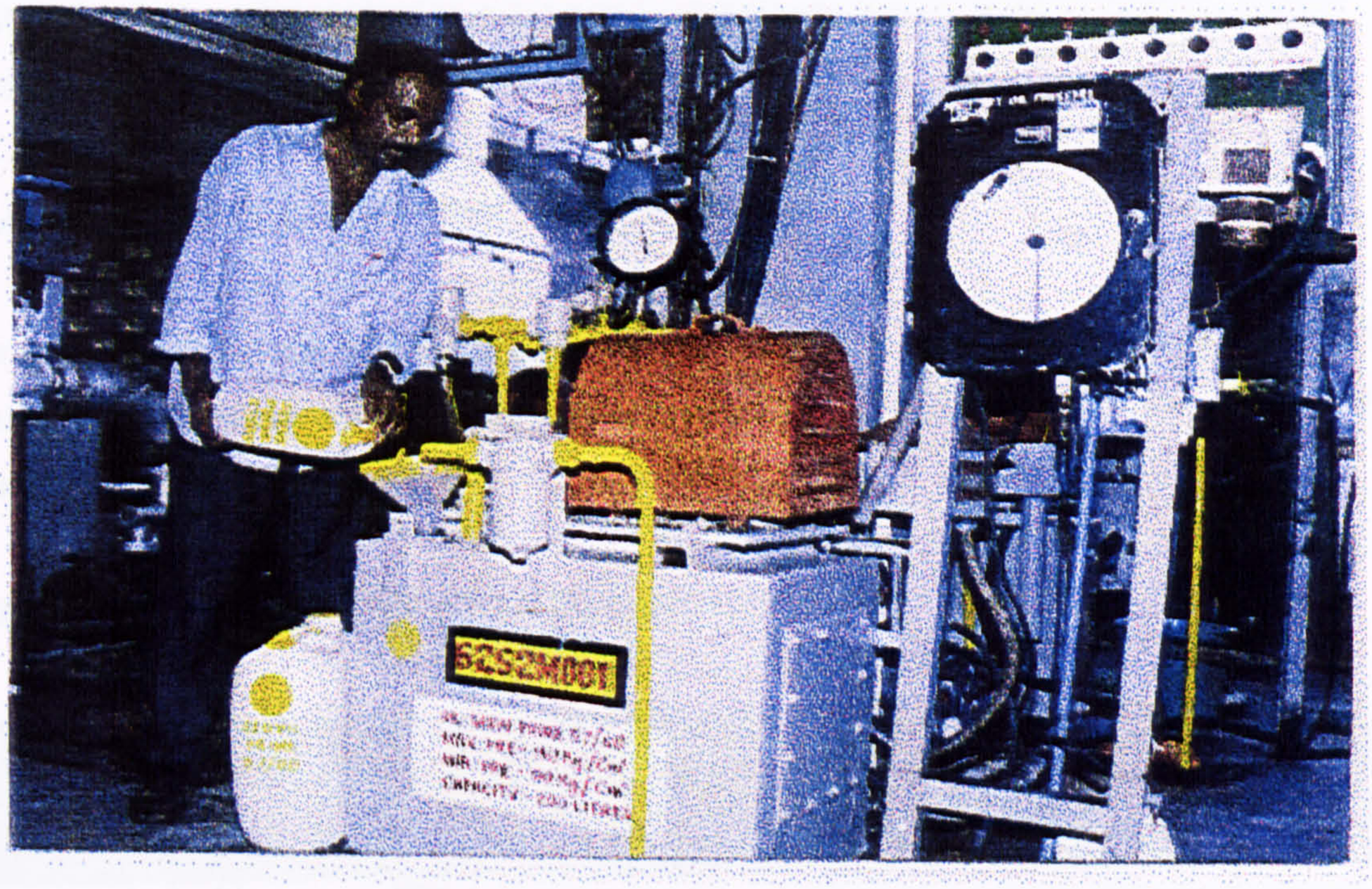


Fig 3.18: Mistake Proofing through Colour Coding

3.4.3 (b) TIME MANAGEMENT

"A man that is young in years may be old in hours, if he has lost no time." (Refer book: John Daintith, Alan Isaacs, Elizabeth Martin, David Pickering, Anne Stibbs, Deborah Chapman, Hazel Egerton, Ruth Salomon, Kate Smith & Edmund Wright (1993), *Who Said What*, Chancellor Press, London.)

"Time is Money" – save customers time and they will give you money. (Refer book: Wallace Thomas F (1994), *World Class Manufacturing – Instant Access Guide*, Oliver Wight Publications, Essex Junction, VT.)

"*Time will be the primary competitive motive of business in the twenty-first century.***"** (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

Time is the pulse of business today, so it is to be managed properly. The delivery has to be On Time-In-Full (OTIF). Supply has to be JIT. Of all the resources available, time is neither abundant nor replenishable. The philosophy of speed must be understood by all organisations.

Key features of Time Management in WCM are:

- Activities are planned. Thinking saves a lot of time, if it is done before the job.
- Parallel processing of job is done.
- Industrial Engineering Techniques are used in manufacturing as well as office activities.
- Planning is done for product launching and attempts are always made to enter the market with new concept or product.

3.4.3. (c) PROBLEM SOLVING TOOLS

In order to achieve zero breakdowns and to eliminate all chronic losses affecting productivity, manpower efficiency, material and energy, World Class Manufacturing process makes use of various problem solving tools.

SIX STEPS OF PROBLEM-SOLVING PROCESS

SL NO	STEPS	QUESTION TO BE ANSWERED	EXPANSION / DIVERGENCE
1	Identify Problem	What do we want to change?	Lots of problems for consideration/ Prioritisation
2	Analyse problem	What's preventing us from reaching the desired state?	Lots of potential causes identified and their linkage
3	Generate potential solution	How could we make the change?	Lots of ideas on how to solve the problem/ Several alternatives
4	Select and plan the solution	What's the best way to do it?	Lots of criteria for evaluating potential solutions, Comprehensive evaluation
5	Implement the solution	Are we following the plan?	Lots of guidelines for implementing the solution, Plan of action
6	Evaluate solution	How well did it work?	Steps for holding the gains

Table 3.7: Problem Solving Steps

Why – Why Analysis

Why-Why Analysis is a simple yet powerful questioning technique leading to root cause of a

problem. The process is to first write the goal or problem, then ask a series of 'Why' questions and finally plot answers

Each answer in then subjected to the question and the cycle repeats at least 5 times to arrive at root cause.

Who can use? - By individuals or Teams

How to use? - There are three simple stages:

Example:

Problem: Flash Over in Terminal Box

Now let us see how one can arrive at the root cause:

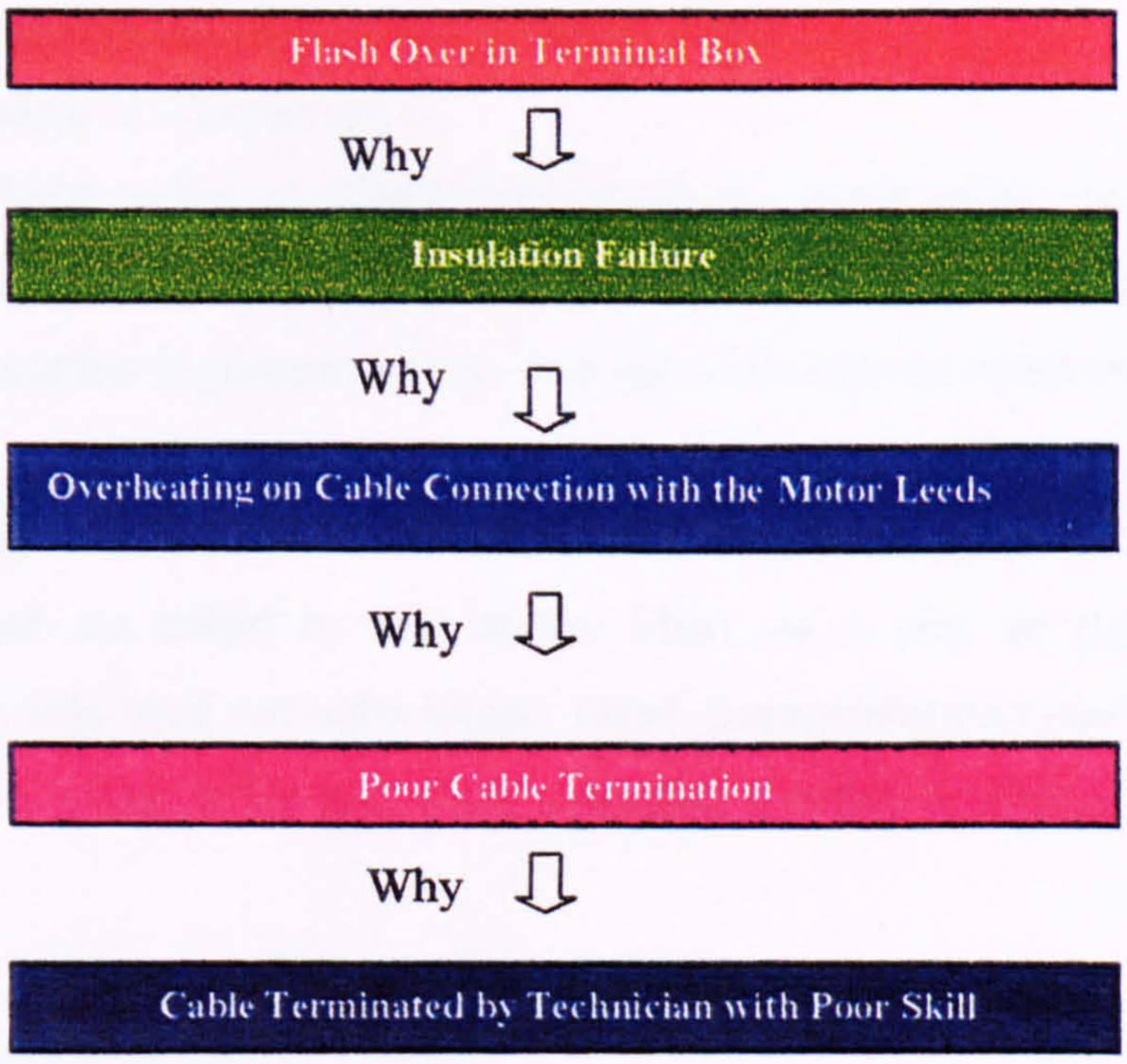


Fig 3.19: Why- Why Analysis

Asking 'Why' at every possible solution in the above problem one reaches to the root cause. Every problem such as Breakdown is followed by a Why-Why Analysis. This way one can attack directly the root cause and reduce the time to repair.

Brain Storming

Brain Storming is a group technique for generating new and useful ideas. It uses a few simple rules for discussion on a subject matter that contributes to originality and

innovation, including idea generation.

"You have good ideas. I have good ideas. Together we have great ideas". (Refer book: Harrington H James, Lomax Kenneth C (1999), *Performance Improvement Methods-Fighting the War on Waste*, McGraw-Hill, New York.)

In Problem Solving one can use both creative and logical thinking. Logic helps us in systematically analysis, to organize the themes, to collect data etc. Creativity is useful in finding solutions to the problems. Brain storming helps to make use of creative abilities of persons in a group and sometimes individuals in an effective manner.

Methods of Brain Storming

Brain Storming may be done in three different ways:

1. Free Wheeling or Unstructured

There is no hold, or bar. A departmental head or a group leader may call his people and explain the subject for Brain Storming and all are expected to come out with their ideas. No limit in number is given at a time. One can reel out even hundred ideas at a stroke.

2. Slip Method

The individual are asked to put his/her ideas on a slip of paper and give it for consideration. One need not write his/her name. Such anonymity makes people to open up freely. When a group is big and when arranging meeting is difficult, this system can be used.

3. Round Robin or Structured Process

All the Team members working together are gathered. A leader is selected for this particular Team meeting. He is open minded, amiable and motivating. He has control over the group to stay on track and at the same time encourage ideas. Everyone contributes in turn and presents only one idea at a time. If one cannot think of any at a given time he says 'Pass', but always gets another chance in the next round.

Cause & Effect Analysis

It is an analytical tool to examine effects or problems to find possible causes and to point out possible areas where data can be collected.

There are four steps in constructing a cause and effect diagram:

- Brainstorm all possible causes of the problem
- Classify major causes under the heading Man, Machine, Material, Method
- Draw the cause and effect diagram
- Write the effects on the diagram under the classifications chosen

An Example:

The effect is the problem of 'Wobble' in winding machine. The Major causes are listed such as Material, Tools etc. The Cause is then split into sub-causes. Again the Sub-Causes can be further split into Sub-Sub Causes. The process establishes total linkage

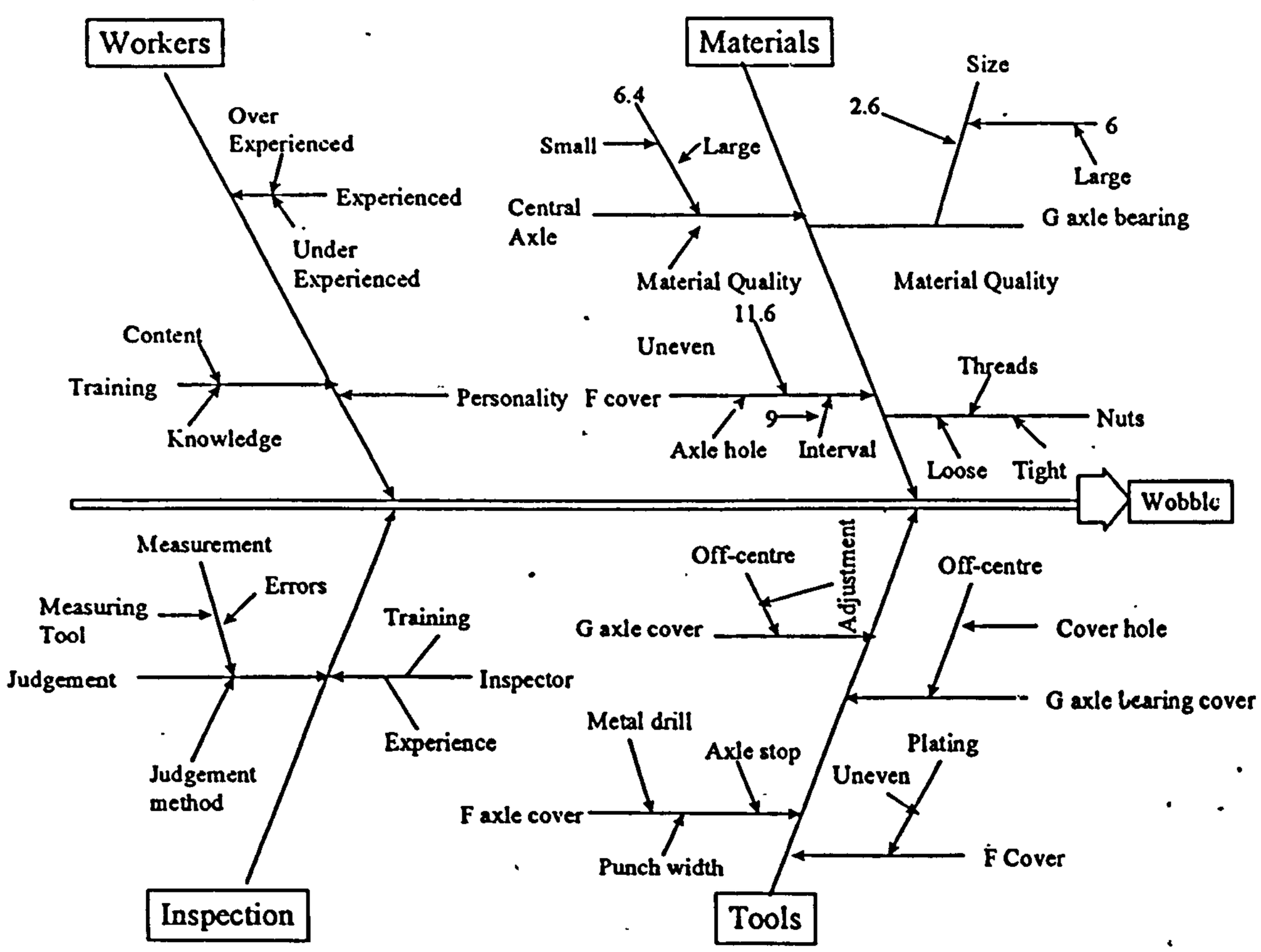


Fig 3.20: Cause & Effect Diagram

of various Minor & Major Causes. e.g.: Material is one of the causes for wobble. 'G axle' bearing is the sub-cause for material. Size of the bearing is sub-sub cause for the sub-cause 'G axle' and bearing Size 6 is the sub-sub-sub cause.

Using the Cause & Effect Diagram:-

No effective and useful cause and effect diagram can be made at one step. Basically they have a very great use as a diagram to give us a deep insight on the issues under scrutiny. Hence one does not consider the diagram making as one time exercise. One understands that they serve the purpose of indicating the areas, which need checks, additions and alterations. Repeated attempts to modify the diagram helps to understand things better. Cause and Effect Diagrams are based on facts.

Cause and Effect Diagram are used in the following ways:

- As an educational tool for clear understanding of processes
- As a guide for discussion
- To find out reason behind the causes in a systematic manner
- To post data for future reference
- A detailed cause and effect diagram making exercise helps to acquire have an in depth knowledge about the process
- For any kind of problem solving

P-M Analysis

Aims of PM Analysis are to understand the nature of chronic loss, failure and defects, to understand the importance of slight defect for eliminating C*hronic Loss.*

Losses are broadly categorised into 2 categories:

Chronic Losses: Indicate smaller frequent deviations that gradually have been accepted as normal.

Sporadic Losses: Indicate sudden, often large deviations from the norms. They normally occur due to a single assignable cause that is easy to identify and corrective measures are easy to formulate.

Chronic losses require innovative breakthrough measures that restore the mechanism or component to its original defect-free state. They are products of more than one cause and need PM Analysis.

What is P-M Analysis?

P- Phenomenon i.e. the event to be controlled

M- Mechanism and also 4 Ms i.e. Man, Machine, Material and Method

The basic principle behind P-M Analysis is to understand in precise physical terms as to what happens when a machine breaks down or produces defect. P-M analysis is a refined version of Cause and Effect Analysis which considers all causal factors instead of trying to decide the most influential one. In order to achieve total elimination, it is necessary to identify all causal factors and control them.

Steps Involved in PM Analysis:

- Clarify the phenomenon: It carefully defines and categorizes the abnormal occurrence
- Conduct a physical analysis: It define how the parts or process conditions change in relation each other to produce abnormality
- Define phenomenon's constituent conditions
- Study production input co-relations (4M's)
- Set optimal conditions (standard values)
- Survey Causal factors for abnormalities
- Determine abnormalities to be addressed (including slight defects)
- Propose and make improvements

Example of PM Analysis:

A PM Analysis exercise conducted at a Fertiliser Unit (Indo Gulf Fertilizers Ltd., India) to eliminate the chronic problem of curved stitching in bags. The step-by-step physical analysis was carried out and the contributing conditions were identified. The relations with 4M's were then assigned through consultation of user and experts. The optimal conditions were defined. A survey was conducted and the investigation results were recorded. Based on the information, the counter measures were suggested. The process of analysis has been narrated on next page in tables.

PM Analysis Work Sheet

Phe-nom-e-non	Physical View (Logical Reasoning)	Contributing Conditions	Relationship with 4 Ms	What the condition must be (Optimal condition)
	Curved stitching	1. Speed of slat conveyor and speed of	1. Worn out feed dog of stitching machine.	1. Teeth of feed dog should be sharp to avoid slippage

		stitching not matching.		
		2. Bags not fed horizontally straight to the stitching machine.	2. Poor grip due to less pressure of pressure foot of stitching machine.	2. Correct pressure of pressure foot.
			3. Loose/worn out V-belt causing reduced speed of stitching machine.	3. No loose/worn out V-belt and motor pulley.
			4. Worn out motor pulley of stitching machine.*	4. Right grip between the flexible jaws of bagging spout.
			5. Bag tilted at filling point.	5. Aligned placement of bags on the spout.
			6. Both hands not used to hold the bag straight..	6. Both hands to be used to hold the bag while feeding to the stitching machine.

PM Analysis Work Sheet (Continued)

Further Columns of above Table shown below and on next page (please match the serials)

Investigation/ Survey	Assess Investigation Results	Proposed Countermeasures
1. Worn out feed dog of stitching machine 2. Less pressure of pressure foot.	No worn out feed but there is chance of getting it worn. Normally being observed.	Regular checking/replacement under preventive maintenance by mechanical maintenance. Checking of pressure foot and its adjustment in every shift, jointly by operation and maintenance.

3. Worn out V-belt and motor pulley	Not observed but may happen.	Regular checking/replacement under preventive maintenance by mechanical maintenance.
4. Bag tilted at filling point due to poor grip of jaws.	Not observed but may happen.	Regular checking of bag grip air cylinder for any jamming/choking and cleaning them. Adjust jaw mounting on regular interval (Preventive Maintenance)
5. Mis-aligned placing of bags on the spout. Not using both hands while feeding to stitching machine.	Videography was done and these phenomena were observed.	Counselling and retraining of bag fillers and stitches.

Table 3.8: PM Analysis

Failure Mode & Effect Analysis (FMEA)

It is an analytical method to assist in the fool proofing of a design or a process. This tool is used while investigating a process to identify possible causes of failure and their effects, or while examining a product or service to look for what can possibly go wrong

How to use FMEA?

Identify ways, the Product, Process or a System can fail. Then plan to prevent those Failures

'FMEA' Helps in:

Identifying the ways in which a process can fail to meet critical customer requirements, estimating the risk of specific causes with regards to these failures, evaluating the current control plan for preventing these failures from occurring, and prioritising the actions that should be taken to improve the process

Steps in the FMEA Process:-

1. Select the Process FMEA team
2. Develop Process map and identify all process steps
3. List all the Key process outputs to satisfy internal and External Customer requirements

4. List Key process Inputs for each process
5. Define matrix, relating product output to Process variables
6. Rank the inputs according to Importance
7. Start the Process FMEA
8. For each process input, List ways that it can vary (Causes) and identify associated Failure Modes (FM's) and Effects
9. List all other causes (Sources of variability) and associated FM's and their Effects
10. Assign SEV (Severity), OCC (Occurrence) and DET (Detection) ratings to each cause
11. Calculate RPN for each potential failure mode scenario
12. Determine recommended actions to reduce all RPNs (Risk Priority Number)
13. Take appropriate actions.
14. Re-calculate all RPNs.

Since RPN is a function of Severity, Occurrence and Detection, whichever has the highest RPN is tackled first. Severity can not be seen in isolation.

Benefits of FMEA

- Helps to identify potential product/process failure modes early
- Assists in the analysis of product/process design requirements and alternatives
- Helps to identify potential, critical characteristics and significant characteristics
- Establishes a priority for product/process improvement actions
- Documents the rational behind product/ process design changes
- Aids in the development of process control plans

PDCA Cycle (PLAN, DO, CHECK, ACT)

PDCA is a standard management technique for ensuring continual improvement. It is a framework, with universal application. Used in conjunctions with supporting problem solving tools, the technique eliminates problems and therefore enables a continually improving process.

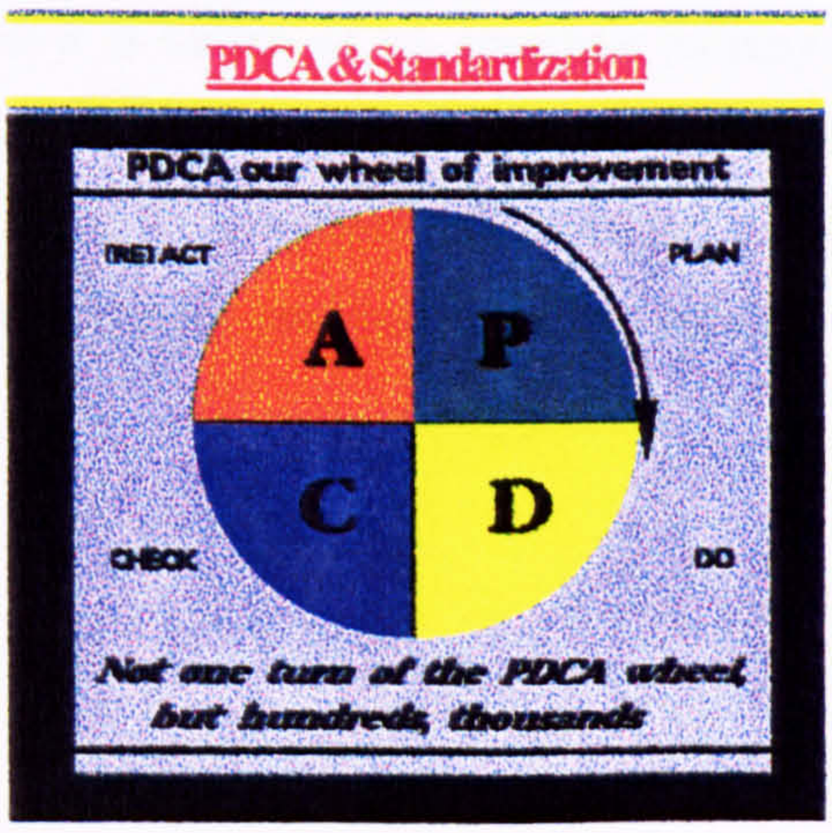


Fig 3.21: PDCA Cycle

PDCA Step by Step:-

PLAN: *The plan must be clear, workable and measurable*

1. The problem to be solved is selected.
2. The activities are scheduled.
3. The current situation is properly understood.
4. Target is set
5. Problem is analysed
6. Improvements are planned

DO:

7. Plan is implemented

CHECK: *The check tells where one is against the plan*

8. Results are checked

ACT: *The (Re) Action is where one standardises and think about further improvement*

9. Improvements are formalized and standardised.
10. Review of improvements and further improvement.

Flow Diagram

Flow diagram is a graphical or pictorial way to depict a process. With the help of a flow diagram, one can show a process sequence. Often it is called as an armchair journey as it helps to have clarity of the process without visiting the actual spot. It can also be useful to dissect a process for better understanding and analysing for re-planning or making a change. Flow diagram is a powerful tool that helps to do a thorough analysis. Problem solving, task forces, quality improvement teams etc., makes use of it.

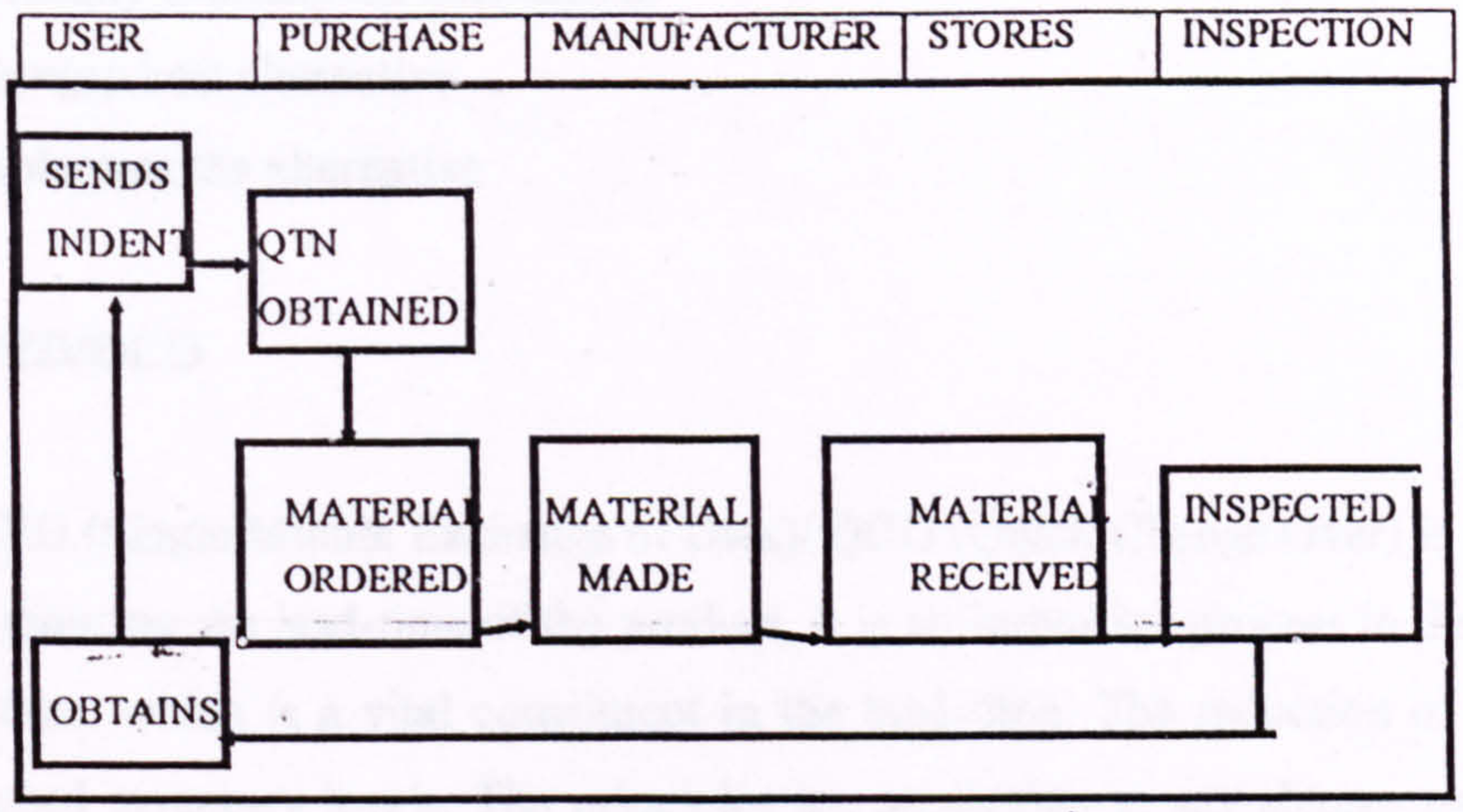


Fig 3.22: Flow Diagram

VALUE ENGINEERING:

Value Engineering aims to simplify product, use better improvement, modify and improve product design, use efficient process, reduce product cost, increase utility of product by economical means, save money or increase profits.

Technique used in Value Engineering:

Each component of the product is analysed with the help of the questions like:

Does it contribute value to end product?

Is the cost proportional to its function?

Can some features be added or eliminated?

Would there be a better product?

Can a component be processed by less costly process?

Can one go for an available standard product/component?

Can it be procured at a lesser cost from elsewhere, taking into account the quantity required?

Is the product being made with proper tool? etc.

Basic Steps in Value Engineering:

- Identify the product
- Collect relevant information
- Define different functions

- Create different alternatives
- Critically evaluate the alternatives
- Develop best alternative
- Implement the alternative

SMED/QCO

SMED (Single Minute Exchange of Dies)/ QCO (Quick Change Over) is one of the tools used for reducing the lead-time of the product. It is an important process in the reduction of the set up time, which is a vital constituent in the lead-time. The reduction of set up time leads to reduced inventory levels. The principles are applicable to any change over operation be it in engineering or in process industry. "SMED is generally viewed as the technical breakthrough that enabled the move towards of pull systems and one-piece flow." (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

Steps involved in SMED:

- Observe and record the existing set up operation with the help of the set up operators.
- Split the setup into individual elements and record the times.
- Perform an IOL analysis of the operation.

ONE POINT LESSON

The One Point lessons illustrates a point of basic knowledge, tips for preventing problems or any improvement topics. The One Point lessons can be categorised under three headings: Basic Knowledge, Trouble Shooting and, Improvement Cases. The idea of One Point Lesson is to make learning a continuous and an enjoyable experience.

These are presented on the activity boards so that it attracts attention of all team members.

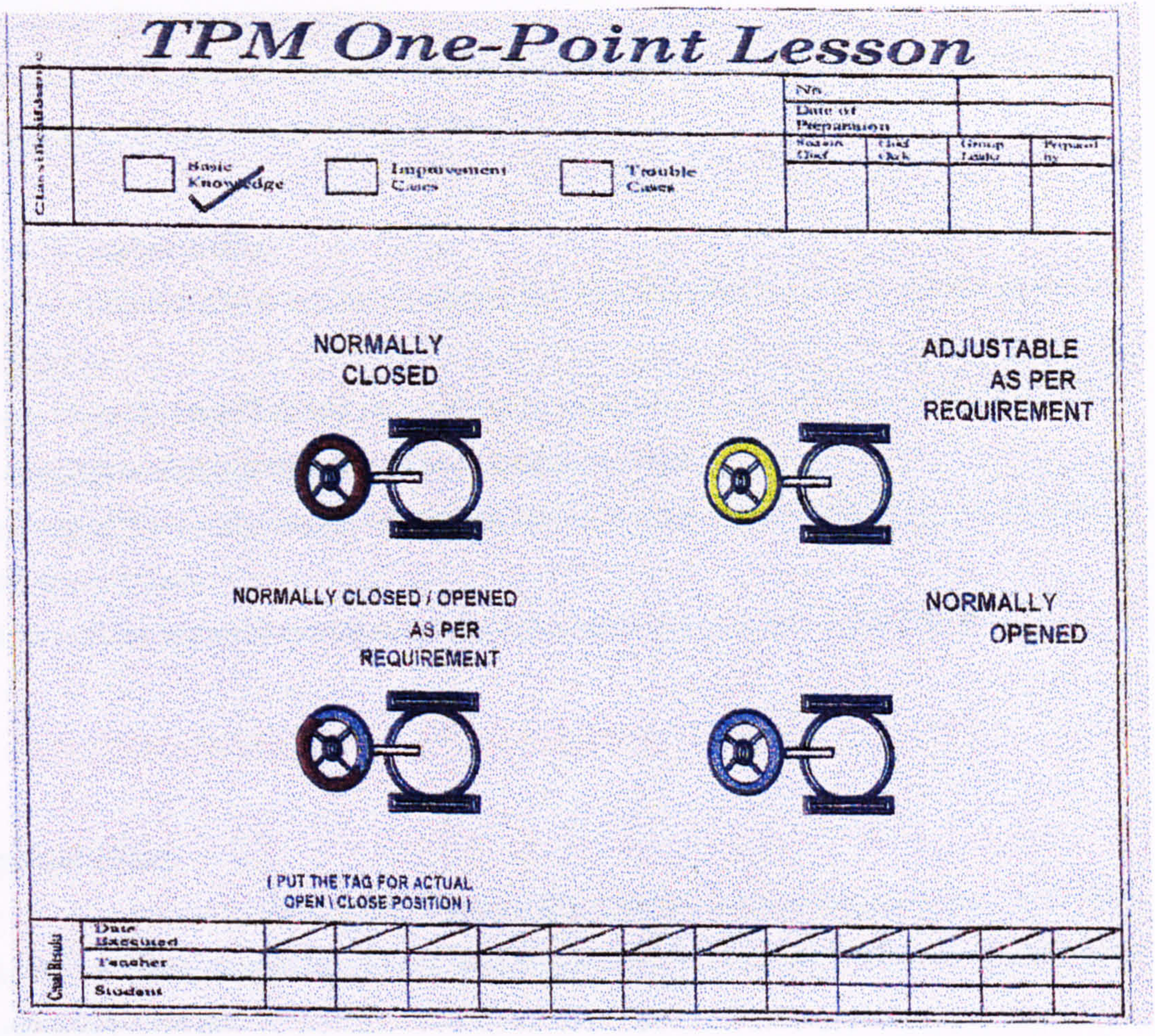


Fig 3.23: One Point Lesson

ZERO ABNORMALITY MOVEMENT (ZAM)

Basic WCM methodology includes standardisation of processes and parameters. Any deviation from these is an abnormality. WCM aims at achieving the Cultural Transformation through **Zero Abnormality Movement (ZAM)** by developing an eye for abnormality identification and a mindset for its removal from the root.

What is Abnormality?

Abnormality is the deviation from standards. The standards are set targets, which, after achievement are further revised for manufacturing excellence. Deviations thus occurred are removed in systematic manner.

Type of Abnormalities:-

The abnormalities which exist in every manufacturing process and services have been categorised into following two groups;

1) Category A: Physical or General Abnormality (Apparent)
2) Category B: Process Abnormality (Latent)

Category 'A' Abnormality:

These types of abnormalities can be physically felt (experienced) by human senses (eyes, ear, nose and hand).

- They can be easily identified and removed by carrying out sincere efforts and adapting Why-Why Analysis to find out their Root Cause to remove them.
- The success of Zero Abnormality Movement lies in the fact that abnormality once removed should not re-occur.
- Based on various apparent symptoms, these have been grouped into Eight Types.

Eight Types of Category 'A' (Physical) Abnormalities:

1. Apparent Defect

Deposit & Accumulation: Dust, Dirt, Powder, Oil, Grease, Rust, Paint, Coolant, Soil, Ash, Sludge, Splash Stain, Sogginess, Leaks Solidified, Debris, Jamming, Water accumulated in Air/Condensate Line etc.

Damage &Deformation: Cracking, Crushing, Deformation, Chipping, Bending, Blasting, Bursting, Insulation/Coating/Lining Corroding, Softened Surface etc.

Play & Gaps: Shaking, Falling Out, Tilting, Eccentricity, Wear, Distortion, Mis-aligned, Rattling Sound, Swaying, Locking, Backlash, Loose Contacts, Deviation etc.

Sway & Slackness: Belts, Chains, Rollers/Spindles, Hangers, Hoods, Stays, Cables, Props, Fasteners Ropeways Bearings Hinge & Linkage

Abnormal Phenomena: Unusual Noise, Overheating, Vibration, Jerking, Resonating, Unusual Smells, Discoloration, Incorrect & Improper Calibration, Improper Fluid Flow, Improper Operation

Adhesion and Restriction: Blocking, Hardening, Accumulation of Debris and of Chemicals, Peeling, Malfunction, Choking, Sticky/Viscous Flow, Leaked Materials- Gas, Water, Steam, Oil, Air, Heat

2. Basic Un-fulfilment

Lubrication/Coolant/Priming/Overflow: Insufficient, Unidentified and Unsuitable, Sub Grade, Hot, Carbonised, Gritty & Dirty, Foaming, Choked etc.

Supply & Systems: Dirty/Damaged/Deformed/Choked Lubricant-Inlets, Faulty/Long/ Haphazard Lubricant-Pipes, Inadequate Pressure and Flow etc

Inadequate Gauges: Dirty/Damaged/Leaking Sight Glasses, Distant location, Improper type, Incorrect Scale & Readings, Low Visibility .

Inadequate Tightening: Slackness in Spring & Fasteners, Missed/Crossed/Crushed Threads, Too Long/Short, Corroded, Wrong/Damaged/Deformed Washers, Unsuitable/Over-Tight Improper Gasket, Mismatched Seats (Tong and Grooves)

Improper Measuring Instruments: Non-calibrated, Inappropriate Storage Condition, Faulty Calibration Method, Dirty, Damaged, Faulty Pressure/Temperature/Volume/Weight/Flow/ Power/Voltage/Current Meters, Integrators & Recorders

Unmatched Equipment & Machines: Under/Over Size, Mismatched, Inadequate Control Devices, Sluggish, Mal-routed, Wrong/Improper Feeders, Inadequate Stirring/Mixing/ Agitation/Crushing/Sizing/Grading, Improper Material Flow and Movement Devices, Restriction /Fitting Obstruction Improper Installation, Induced Vibration, Frequent Monitoring, Improper Layout, Overhanging, Loose Base etc

Defective Design: Design/Shape/MOC of Nuts and Bolts, Equipment, Belts, Chains, Bearings Gaskets, Glands, Hooks & Props etc.

Lack Of Maintenance: No Maintenance Schedules and Records, Improper Maintenance Planning/Resources etc.

3. Non-approachable Places

For Cleaning: Shape/Construction/Layout/Installation of Covers/Footholds, Space around the Machines and Equipment

For Checking: Construction/Layout of Covers, Instrument Position, Orientation of Main Panel/Meters/Recorders, Operating Range Display, Material Level in Silo/Tankers/Wagons/ Gear Boxes To Lubricate Position of Inlet, Construction, Shape, Height, Footholds, Lubricant Overflow, Drainage etc

For Tightening: Covers, Construction, Layout, Size, Footholds, Dusty/Fuming/Dark/Hotter Zone etc.

For Operation: Machine Layout, Position of Valves, Switches and Levers, Footholds, Starters, Breakers etc.

For Adjusting: Position of Pressure Gauges, Thermometers, Valves, Relays, Controllers Flow Meters, Moisture Gauges, Vacuum Gauges, Level Sensors, Limit/Time Switches

4. Outside Contaminants

From Product: Leaks, Seepage, Overage, Spent, Spoiled, Spills, Spurts, Scatter, Overflow

By Raw Materials: Leaks, Spills, Spurts, Scatter, Overflow etc.

By Lubricants: Leaking, Spilled and Seeping Lubricating Oils, Hydraulic Fluids, Fuel Oil

By Gases: Leaking Compressed Air, Gases, Steam, Exhaust Fumes, Oil Vapour etc.

By Liquids: Leaking, Spilt and Spurting Cold/Hot Water, Half-Finished Products, Cooling/ Washing Water, Effluents, Wastewater, Oil etc.

By Scrap: Flashes, Cuttings, Packaging Materials, Metal Cutting/Filings, Nonconforming Product, Sand, Gritty Matters, Spent Set/Over-aged Resin, Rubber etc.

Other Carriers: Contaminants brought by People/Fork-Lift/Trucks etc. Infiltration through Cracks in Buildings/Hoppers/Chutes/Bins/Silos etc, Pollutants ingress by Wind/Storm

5. Reason of Quality Defect

Due to Foreign Matter: Inclusion, Infiltration, Entrapment of Dirt, Rain Impurity, Rust, Chips, Wire Scraps, Insects etc.

Due to Shock: Dropping, Jolting, Collision, Vibration, Skidding/Slipping, Sudden Stoppage, Thermal Stress etc.

By Moisture: Wide Variation, Absorption, Condensation Leak Too Much, Too Little, Infiltration, Condensation.

Due to Grain Size: Crushing, Screening, Disintegration, Separators, Abnormalities in Screens/ Centrifugal Separators/Compressed Air Separators etc.

Changed Viscosity: Inadequate Warming, Heating, Compounding, Mixing, Evaporation etc

Improper Process Controls: Inappropriate Setting/Control of Parameters, Inadequate Standard Operating Procedures (SOP), SOP not Updated, Poor Techniques, Use of Crude Tools, Controlling with Trial and Error, Rough Handling of Machines/Equipments Measurement System, Use of Non-validated/Crude/Sluggish Measurement Systems

Human Error: Non Compliance to SOP, Inadequate Training/Knowledge

6. Materials Obsolete & Non-Urgent

Machinery & Equipment: Pumps, Fans, Blowers, Compressor, Columns, Tanks, Agitators, Vessels, Elevators Conveyors, Crushers, Pulverisers, Ball Mills, Heat Exchangers, Coolers,

Interface Connection & Piping: Pipes, Hoses, Ducts, Valves, Dampers, Chutes etc. Measuring and Control Instruments, Temperature/Pressure Gauges, Voltmeters/Ammeters, Electronic Ears, Sound/Gas Emission Monitoring, Relays Switches, Regulators, Instruments/Gadgets long awaiting for spares and repairing parts etc.

Electrical Equipment: Wiring, Piping, Power Leads, Switches, Plugs, Sockets, Fuses, Stampings, Insulators, Circuit Breakers etc.

Jigs and Tools: General Tools, Cutting Tools, Jigs, Moulds, Dies, Frames, Fixers, Pulley Blocks, Jacks, etc.

Spare Parts: Standby Equipment, Spares, Permanent Stocks, Auxiliary Materials, Obsolete or Surplus etc.

Makeshift Repair Tools: Tape, String, Wire, Metal Plates, Scaffoldings Sealant, Clamps, Brackets etc.

7. Accident-prone Areas

Floors: Unevenness, Ramps, Cracking, Peeling, Worn (Steel Deck Plates), Oil Spills, Water-logged, Slippery etc.

Steps: Too Steep, Irregular, Peeled/Torn Anti-Slip Covering, Corrosion, Missing Hand Rails

Lights: Dim, Out of Position, Dirty or Broken Covers, Non-Explosion Proofed etc.

Rotating Machinery: Displaced, Fallen Off or Broken Covers, No Safety or Emergency Stop Devices, Missing Guards etc.

Lifting Gear: Unsafe Wires/Hooks/Brakes and Other Parts of Cranes & Hoists, Absence of Fencing .

Others: Explosive Substances, Solvents, Emission of Toxic Gases, Insulating Materials, No Danger Signs, No Protective Clothing, Unguarded Pits/Platforms, Shield for Weld-spark/ High Voltage/Explosive Storage/Loose Wires.

8. Lacking Practices

Man (Human Error): Non Compliance to SOP, Safety Devices like Helmets/ Gloves/Goggles not Used, Improper use of Tools, Careless/Unconscious/Overconfident worker.

Material (Safety Equipment): Inadequate/Improper Safety Equipment, Dislocation of the Equipment, Poor Condition of the Safety Equipment, Expired, Rusted/Damaged etc.

Method (Inadequate Information): No Visual Displays/Caution Boards, Inadequate Training.

1. **Deviation from Target**

Manual operation for precise control, Non-standard techniques in process, Inadequate Specification of input, non adherence to SOPs, Unplanned or Untimely or Delayed or Hurried Actions etc.

- . Look for out of range in the dials of gauges
- . Check for blockade/choke/restriction in passages as indicated in the flow indicator on-line.
- . Compare quality parameters of input with target
- . Check if you have missed some items of the compliance check-list at start of the duty
- . Are your all instruments and control devices, accurate & precise?

2. **Effectiveness of E&M**

Unmatched size (capacity), Unsuitable MOC, High maintainability & operability, Limited Resources or provisions for line-up and recycle or rework or resetting, Inadequate or no proper measurement of quality parameters or performance parameters.

- Check for capacity match of the equipment or machinery with respect to the system
- Calculate the OEE, OME, OPE etc.
- Analyse high rate of replacement or consumption of components with respect to the respective duty conditions in context of design and MOC etc.
- Check for the bath capacity or batch sizes in reference to the retention time or reaction time
- . Check operability for the full range, not partial
- Check safety control & PPE appliances for safe and sound working condition
- Check condition of Partition, Covers, Baffles, Muffs Enclosures, and Insulation etc for any disorder or dislocation or leak or damage etc
- Check for the flexibility of the process or system to adopt the anticipated Changes, Re-entry, Recycle, Re-work Rewinding, Re-start etc. Check the availability of the proper measuring instrument
- Check for the Accuracy and Least Count of the Metering, Measuring, instruments & gauges used for the purpose of controlling the quality, quantity, shape and sizes of the intermediate or final product
- Use following indicator after developing to suit your requirement of indicating

Internal Failure of the Function:-

(i) Leakage or Percolation from one chamber to other

(ii) Escape or leak of fluid through the Barrier or Seal

(iii) Blockade of the lubrication passage

(iv) Loosen Collate or Keys or Check-nuts generating play, sound, vibrations etc

(v) Collapse or damage of lining of Kiln or Boiler showing hot spots

(vi) Back pressure caused by leaky NRV or lost capacity of respective work station

3. **Un-stability of Process**

Variations etc. Temporary and Reversible Reactions, In-active Catalyst or Medium, Casual Impacts of Vapour Locks or Water Hammer or Thermal Fluctuations or Temporary Work etc. Un-stability due Jammed Components or Changed Reactions or Interrupted Burning or Sudden Back Pressure or Flow

- Check working life of the catalysts or media for activity vs. expiry and physical conditions
- Use SPC to evaluate the process variations
- Be on a look for any abnormal Shaking, Shattering, Sound etc. caused generally due to Vapour Locking or Water Hammer.
- Analyse the unusual expansion or Contraction, Hot Spot, Temperature Fluctuation, generally caused due to thermal imbalance or shifted heat zone or collapse of thermal insulation or unstable operating parameters of the heating system (Burner or Heater or Coal etc.)
- Check for sudden Back Pressure caused due to improper reactions or burning etc. resulting from the malfunctioning of pump or blower or fuel jet or burner or feeder

4. **Incapability of Process**

Inadequate & inefficient Metering or Control Appliances, Constraints of Unbalance Inputs, Technical Bottlenecks, Sluggish or Slow or Rough Measuring Meters and Methods, Scaling & Sludge Deposits, Operational Changes or Stoppages, Non adherence to Systematic & Scheduled Working, Technological Limitations etc.

- Check for specification of the Input parameters
- Check technical capability and Limitation of the Metering and Control Devices or Appliances
- Check Consistency and physical condition of the Inputs and Chemicals

- . Check for Technical Bottleneck or Limitation of function of element (asset)
- . Check for Jamming, Backlash, Restriction in motion, Dry Bearings etc. resulting in delayed function
- . Check for the Accuracy of Method and Medium deployed for measuring process parameters
- . Check for Scaling and Erosion affecting the Flow, Heat transfer, Drying or Cooling
- . Check for Sludge deposits in vessels & tanks by using Visual Indicator
- Check for Choking of Strainers, Filters, Screens, Piping etc
- Check for unusual Variation in Operating Speed, Feed, caused due to Fluctuation in Voltage, Pressure and Operating Techniques etc
- Look for any Forced adjustment made to accommodate the situations beyond control
- Analyse Technically the Deviation vs. TAP
- . Evaluate LCC to conclude for Technical Up-gradation

2. <u>Sequential Bottlenecks</u>

Location of Work Station & Layout, Sequential Function affecting Flexibility, Limited control on time,

- Study the factors of process variations caused due to Layout constraints
- Conduct TOC study of the present set-up
- Look for any Time Constraint or Complexity in the process
- Study the feasibility of Cellular Manufacturing to combat the bottleneck of sequential working
- Keep an eye on any Back logging resulting due to Functional Failure

3. <u>Lost Continuity</u>

Flickers or Disruptions, Breach/Drop in Pressure or Flow or Temperature or Voltage etc., Restrictions/ Choking of passage or Screen, Scaling/Failure of lining, False operation or functions, Dead Sensors, Bath processing, Hold-ups, Multiple Handling, Temporary functions, Extra precaution required during temporary storage etc.

- . Use Andon and/or Jidhoka to indicate and monitor the Flickers or Interruptions in the process

  Example: - Zero Speed indicator using Proximity switches, Over load switch connected with flickering light or a hooters or alarm etc.
- Check for proper functioning of Control Devices for; Pressure, Flow, Temperature,

Voltage etc.

- Verify & insure that NDT and Condition Monitoring is systematically being carried out for all critical Equipment, Vessels, Piping and Machinery
- Include inspection activities like Quality of Cooling Water, Cooling Effect, Skin Temperature, Conductivity, Hardness, Bleeding or Blow down frequency etc in the *SOP Compliance Confirmation Check List.*
- Include inspection activities like; Condition of Crushing Media, Screen, Belt, Hopper, Conveyor, Feeder, Separator etc in SOP Compliance Confirmation Check- List
- Check whether all Critical Valves have been provided with Valve Open/Close Position Indicators
- Check the parameters of intermediate product Before & After any Hold-up or Inter-batch processing (This is for inferring the energy loss)
- Study the material handling system for computing losses due to NVA activities
- Carryout Time and Motion studies to infer unnecessary activities of Packing, Stacking, Storing etc.(This to compute time and motion loss)
- Check whether proper precautions towards Safe Handling and Protection Procedures during temporary or intermediate storage are observed to avoid perishing or re-working
- Check for any constraint in the procedure which is susceptible to cause the *Loss of Continuity*

7. Quality Factors

Composition, Bulk Density, Porosity, Warping, Wrinkles, Trueness, Surface Finish, Tensile Strength, Hardness, Conductivity, Insulation, Denier, Setting, Shelf Life, Colour, Viscosity.

- Compute the Cost of Quality (COQ) and prioritise the control on parameters affecting the quality
- . Look for any deviations in Quality due to the following reason:-
    1) Composition, Bulk Density, Porosity, Coarseness, Fineness
    2) Shape, Size, Warping, Wrinkles, Texture, Blisters or Scratches on surfaces Tensile Strength, Hardness, Brittleness Malleability, Elasticity, Plasticity, Denier, Crushing Strength, Turbidity, Whiteness, Colour, Transparency
    3) Chemical Reactivity, Concentration Acidity, Alkalinity, Viscosity
    4) Stability, Set-Time, Shelf Life
- Electrical Conductivity, Thermal Conductivity, Thermal Insulation, Electrical

Insulation, Dielectric etc

- Study the cases of High Rejections which have suddenly cropped in.

Example:- Increase in width of lamination in HDPE bag lining, Increase in the Dross quantity due to fall in temperature, Defect of surface flaws generating during Sheet rolling etc.

- Check the quality of input which directly are affecting the quality of Output/ product
- Check for harmful ingredients which directly cause the deterioration in quality

8. <u>Non Value Adding Activities</u>

Repeated work of Mixing, Drying, Blending, Reworking, Material Handling, Recording or Logging, Inspecting, Unplanned Stocking & Storing etc

- Check for repetition of activities like; Mixing, Cooling, Heating, Drying, Flaking, Concentrating, Filtering, Re-melting, Screening, Grinding, Crushing, Micronizing etc which are otherwise not planned in the Standard Schedule
- Check for any additional activity of Intermediate Placement, Stacking etc which does not add any value to the process or function
- Check for any underground storage, which require additional pumping and occupy valuable space as well as pose serious threat of Ground Pollution. (In addition, they suffer with the biggest bottleneck of cleaning and accessibility to repair)
- Look for Unplanned activities of Material Handling which could otherwise be eliminated or postponed and/or synchronized to cut down or reduce cost
- Identify unnecessary repeated recording and logging which does not add any value
- Check the procedures and steps being followed in Purchases, Stores Finance Accounts, Administration, Utilities and Services etc. which does not add any value
- Conduct Process Mapping and compute COQ for all activities.

9. <u>Unsafe Functions</u>

Explosion prone Functions, Processes involved in Manufacture, Handling of Explosive Materials, Grinding and Screening, Producing Explosive Mixture, Statutory Non-compliance.

- Check for proper functioning of Flame Arresters and Lightening Arresters
- . Check the functioning of seal legs provided in the drains or vents of the equipment and vessels containing Hazardous and Explosive substances like Hydrogen, CO, Chlorine, Fluorine etc.
- . Check for the proper insulation and earthing of the electrical appliances, operating in

explosion prone areas and whether flameproof motors, lights, plugs, sockets etc. are being used in the explosion prone area.

- Confirm that the consequences of all Unsafe Functions are displayed at relevant places
- . Check whether sufficient information is available at the point of bottling and dispatch
- . □nsure that the effluent drains are regularily monitored for discharge within the prescribed (allowable) limits
- . Check for proper functioning of the Water Sprayers, Sprinklers in dust prone areas like Coal Handling, Coal Crushing, Stone Crushing, Bowl Milling, Grinding, Micronizing
- . Check for proper functioning of ESP and ETP
- . Check whether all pits and chambers have been properly covered and are provided with hand railings etc
- . Are all employees following the standard practice of wearing PPE during duty period?
- . Is your Dispatch area fully equipped with Emergency Kits, PPE and Fire Fighting Equipment etc.?
- . Is there a regular practice of KYT against dangerous occurrences being performed?

10. Environmental Impact

Work atmosphere, Escape of Smoke, Dust, Steam, Vapour, Gas etc., Percolation of Mercury, Copper, Chromium & Hazardous Heavy Metals, Excessive Sound, High content of Chlorine, NOX, SOX, CO2, CO etc. in Ambient Air etc

- Insure that effective Disaster Management Plan has been prepared and is being updated & practiced regularity
- Check that all employees and surrounding inhabitants within affected range are fully aware of the System to fight out Disaster.
- Is regular Monitoring being done to maintain the allowable limit of pollutants in air?
- Are all effluent drains being monitored for discharge as per the norms?
- Are all Statutory compliance (vig. Inspection of Tools and andackles, Stability Certification of the building and installations, Revalidation of the storage certificate from Chief controller of Explosives, Certificate of permission to discharge the pollutants including ground & air from Pollution Control Department, other licenses from Labour and Factory
- Inspect-oration is being followed regularly?

- Is there sound and effective rapport with Local Administration, Local Activists, Factory Inspectorate, Pollution Control Authorities, Employees, People and Society Are there Set arrangements with CMO, Fire Station and Local Hospitals to tap the resources during emergencies?
- Are all emergency instructions been displayed sufficiently at all relevant places?

MULTI SKILLING

If an employee develops competence in one field only, it is likely that they may become obsolete soon. Therefore in World Class Manufacturing, Multi-Skilling is a must. Any employee remains Competitive and Competent by Virtue of his being Multi-Skilled. They add flexibility to the organization and the change process becomes easier.

3.4.3 (d) Visual Competition

Teams define their QCDIP in terms of their customer's expectation.

In the third and the final step, Visual Competition amongst the teams is created for improving the individual team's **QCDIP** Score. WCM strives for cent per cent marks for each team by their customers, External as well as Internal. The performance of the operating team is judged through the QCDIP scores, which is a reflection of their level of achievement as compared to what was expected of them. This performance is reflected on the QCDIP board, which is appropriately located in the factory. The team with the highest score is suitably rewarded and recognised by the Top Management in Mass Communication Meetings. There can be more than a single winner. This by itself creates a spirit of healthy competition amongst the teams. Sometimes it is observed that a team was consistently performing very badly. In this case the Top Management decides to declare the ownership area of the concerned team as a '*Model Area*'. This results in providing more focus to the above-referred area. All the levels provide all the necessary inputs to this area, which serves as an **Excellent enabler to convert this area to a Model Area**. Similar practice would be then horizontally replicated for all such problem areas in the entire factory. This entire exercise results in a highly motivated, quality focussed, customer driven and an inspired team.

3.5 IMPLEMENTATION

Effective Implementation of WCM Program requires a Facilitating Structure with theclear-cut responsibilities that can look after all the activities related to the implementation of Seventeen Steps Master Action Plan.

3.5.1 WCM Facilitating Structure

One of the most powerful determinants of what happens in an organization is its structure. The outline of this structure was developed at the Corporate World Class Manufacturing Cell under the able guidance of the author for effective deployment of the WCM initiatives in any organisation.

WCM requires a formal Facilitating Structure to guide, implement, and develop the program on a sustainable basis.

WCM Facilitating Structure includes: WCM Promotion/Steering Committee, WCM Secretariat/Promotion Office, Various Sub- Committees and Teams.

WCM Secretariat:

Members of secretariat are drawn from various disciplines like operation, maintenance, commercial etc. The number of members in the secretariat depends on the strength of the organisation. For example an organisation of about one thousand employees, a four-member promotion office may be ideal. The members of the secretariat have good communication skills, a quest for change and an inner urge to motivate others. The members also have an inherent capacity to plan and execute activities independently. The WCM secretariat members act as facilitators for WCM program implementation. However, the actual implementation of WCM program is through the Steering Committee, Specialised Sub-committee and **Teams.** Composition of teams covers all the employees.

Steering Committee:

It is the apex body for the implementation of WCM initiative. It is headed by the CEO, and includes Sub-Committee Leaders, WCM Secretariat Head and Senior Representatives of the Organization. To accelerate the WCM activities the Steering Committee meets at least once in a month and monitors the Progress of WCM Activities. The Steering Committee should provide the inspiration through *leadership* and *commitment*. The Steering Committee is responsible for implementing Road Map through Review, Monitor and Corrective Actions.

Facilitating Structure:

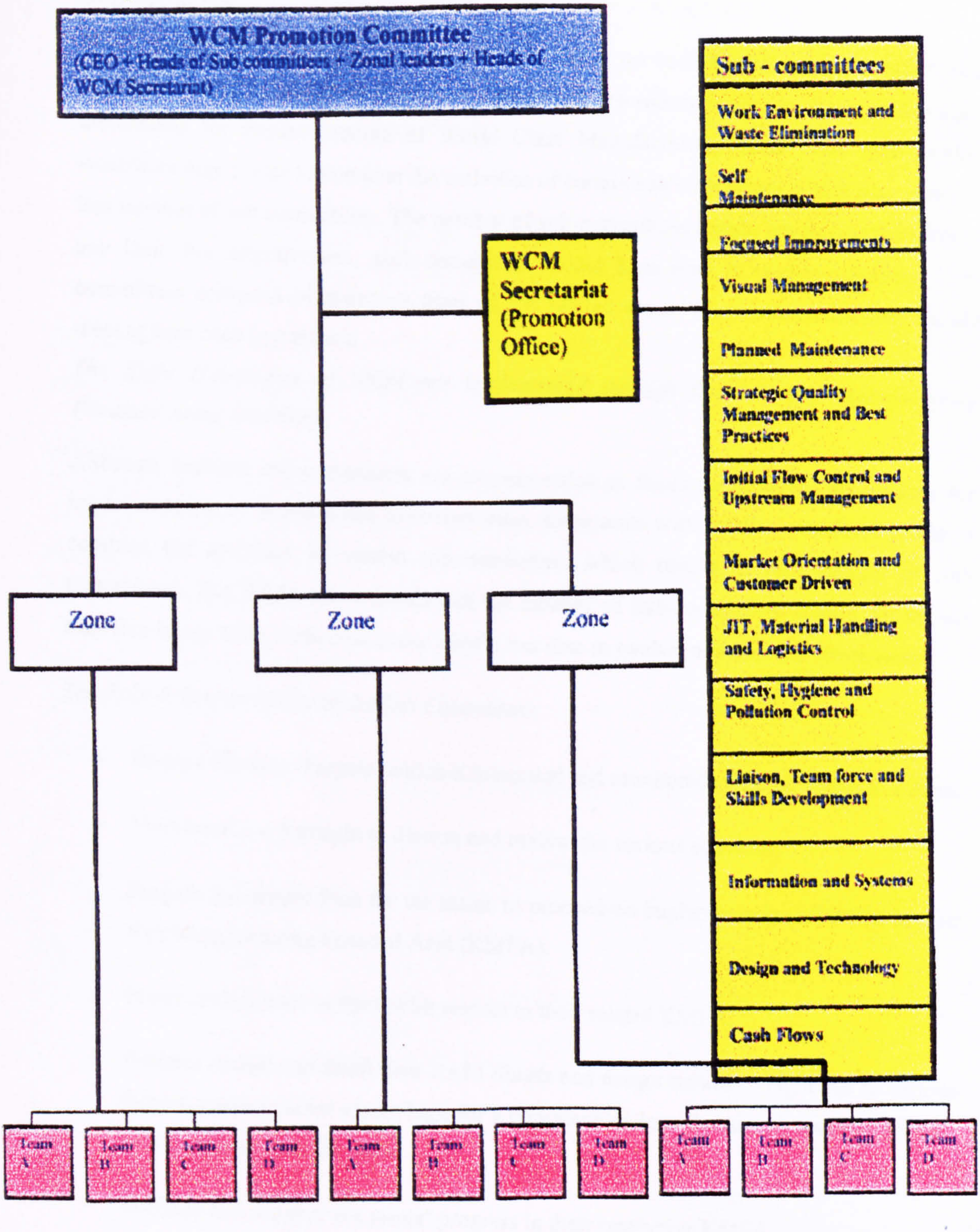


Fig 3.24: WCM Facilitating Structure

Sub-committees:

WCM prescribes fourteen Sub- Committees to focus on each KMFA (Key Manufacturing Focussed Area). Although fourteen sub committees are recommended to focus on the eight dimensions for implementation of World Class Manufacturing, some units with smaller workforce may prefer to combine the activities of certain sub committees which may result in less number of sub committees. The number of sub-committees should not be less than five in any Unit. For effectiveness, each committee should have nine to twelve members. Sub-committees comprise of members from all the related areas. These sub-committees should meet at least once in a month.

The Eight Dimensions of WCM are implemented through fourteen Key Manufacturing Focussed Areas (KMFAs).

Although fourteen sub-committees are recommended to focus on the eight dimensions for implementation of World Class Manufacturing, some units with smaller workforce prefer to combine the activities of certain sub-committees which results in less number of Sub Committees. But WCM recommends that the number of Sub-committees should not be less than five in any Unit. Each committee ideally has nine to twelve members for effectiveness.

The Role & Responsibility of the Sub Committees:

- Prepare Mission, Targets (which is measured and monitored) for their respective Area.
- Meet once in a fortnight to discuss and review the various activities.
- Prepare the Master Plan for the teams to proceed on implementation of WCM in their Key Manufacturing Focused Area (KMFA).
- Measure the losses in Plant with respect to their related KMFA.
- Perform Audits and Draft their Audit Sheets and assign suitable weight age to various factors. Once a factor scores high for a considerably long duration, its weight age can be reduced in the audit sheet.
- Measure and Monitor the teams' progress in their respective KMFA.
- Identify and Take up Major Improvement actions if any deviation from master plan is noticed. This is done on the guide lines of PDCA cycle.

- Guiding the Operating Teams by discussing and solving the problems.
- Provide Training and Education to Operating Teams.
- Setting up of Model Equipment/Areas in Plant and proliferate the knowledge throughout.
- Overall responsibility of WCM implementation with respect to their assigned KMFA and Inter Sub Committee Co-ordination to achieve the same.

The meeting of sub committees discuss the future course of action, review of current status, improvement process, removal of bottlenecks, target for next month, and other related topics.

Example;

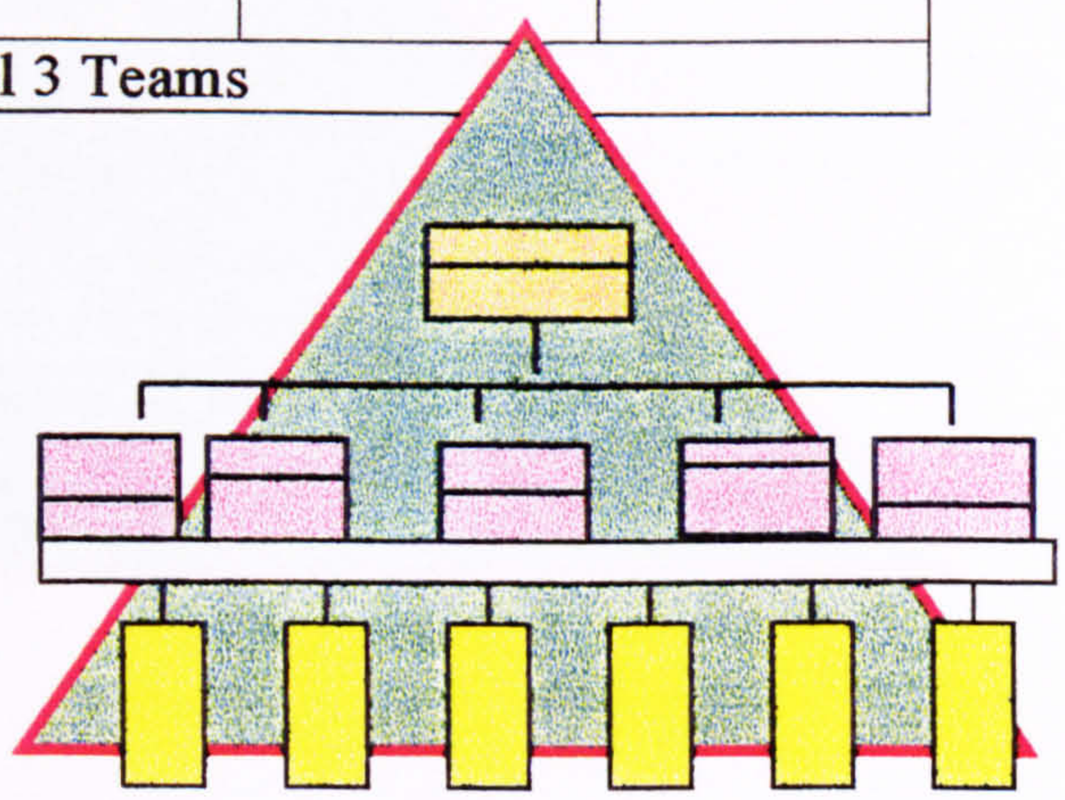
PT Indo Liberty embarked on their journey to excellence in May, 1998 with the creation of Facilitating Structure comprising of Steering Committee, 12 Sub-Committees, WCM Secretariat and Cross Functional Operating and Project Teams to make the company a **QCDIP Driven Company** at every level. The following is a glimpse of the initiatives:-

Example: Creating the Facilitating Team Structure at PT Indo Liberty, Indonesia:

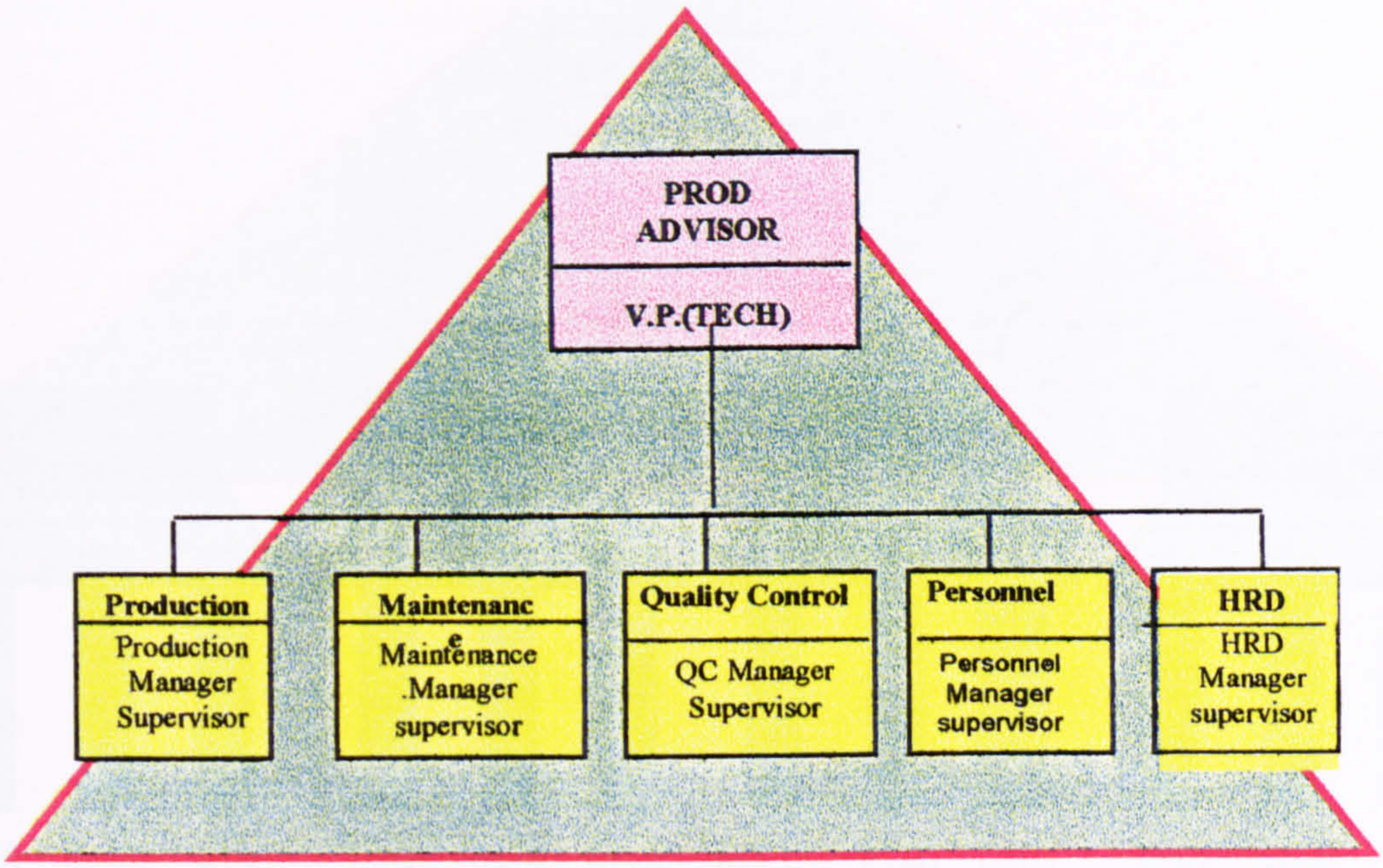
The top management act as facilitator of mentor for the teams. This facilitating structure is headed by the CEO.

Composition of Steering Committee

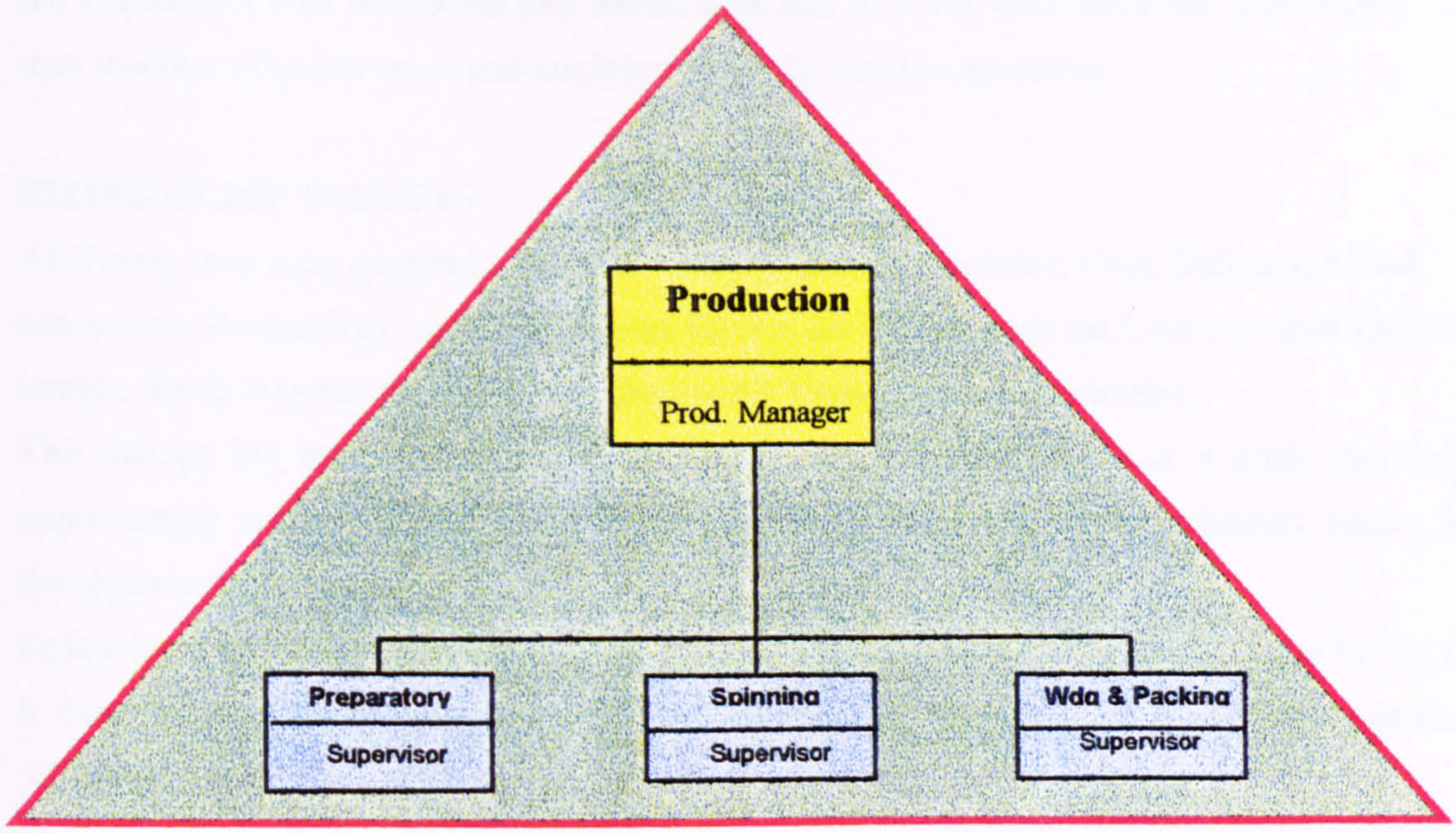
President Director					
Technical Advisor	Engineering Advisor	Finance Advisor	Marketing Advisor		Personnel Advisor
Leaders of KMFAs	WCM Secretariat Head	Leader of Project Teams	Zonal Leaders	Six Sigma Champions	Union Leaders
Leaders of Level 3 Teams					



Sectional Head Team: (Level 4 & 3)



Production Teams: (Level 3 & 2)



Preparatory Teams: Level (2 & 1)

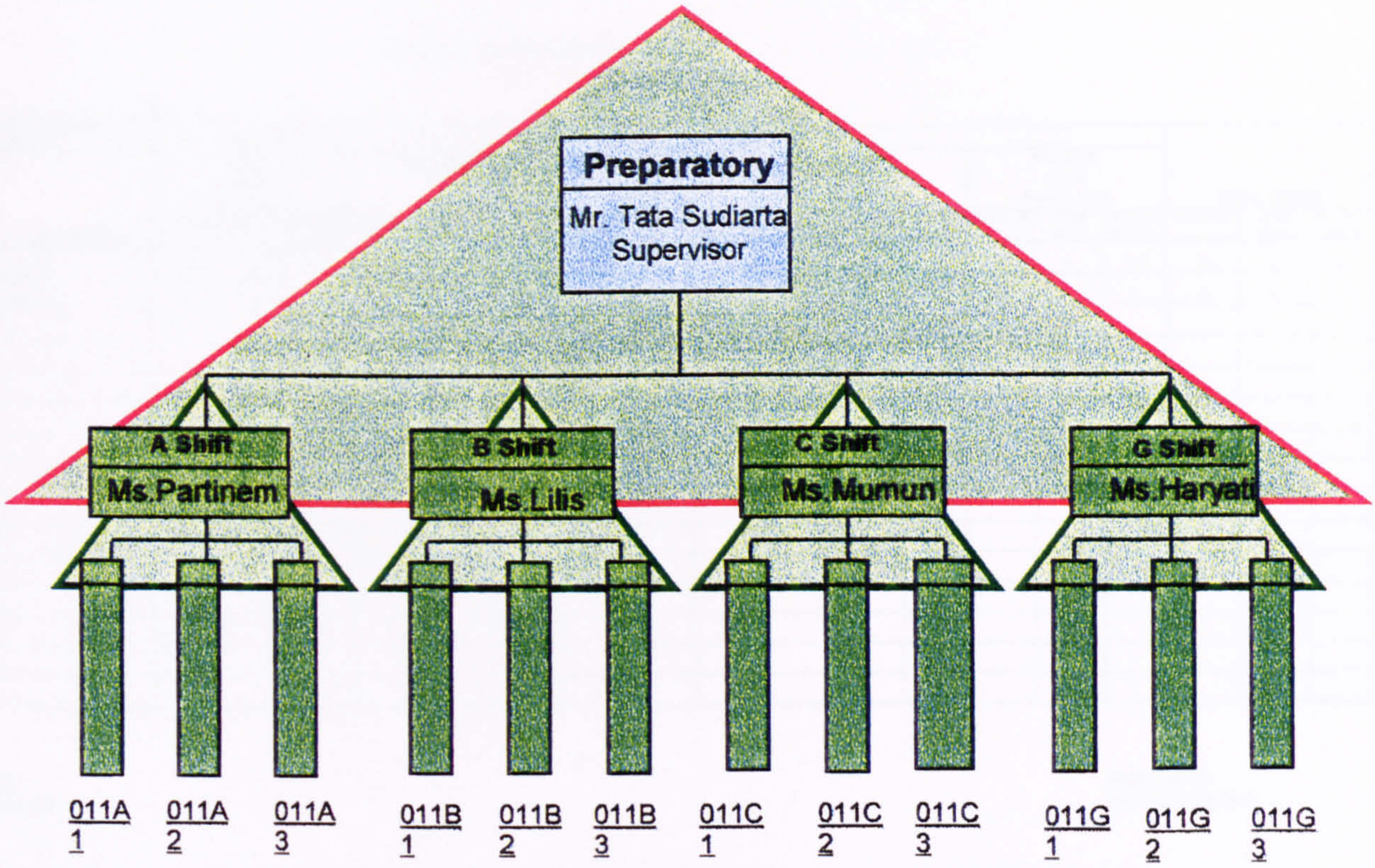


Fig 3.25: Facilitating Team Structure at PT Indo Liberty

All Teams are **Cross functional and Multi skill**; that is, every team has a full time or part time member of maintenance and engineering along with the operators.

FIXING QCDIP TARGETS:

All Teams have been assigned a target in terms of Quality, Quantity, Cost, Delivery, Speed, Innovation, Productivity and Pride. These targets are linked with the Unit's overall QCDIP targets, which in terms are linked with the overall **Vision** of the organisation.

This linkage has been understood by all employees, and they take it as a pride that their improvement in their QCDIP target in their respective ownership are is ultimately adding to the organisation's Vision.

Following is a QCDIP Chart of PT Elegant Indonesia showing how the computation for QCD is done and how the weightages are allotted for Kaizens, Why-Why Analysis, Meetings and 5S/Waste. **(Refer CD-1, Exhibit 3.9**, QCDIP Chart PT Elegant)

WORLD CLASS MANUFACTURING
QCDIP CHART

Zone Area : Mill 1. Ring Frame & Winding

MONTH : June 2002			QCD			PROCESS												TOTAL SCORE		
			QCD (40%) Max Score 40			Kaizen/Inovation (15%) 1 No./Month			Why Why Analysis/PS tools (15%) 1 No./Month			Meetings (15%) 2No./Month			5S/MUDA (15%) Score > 80%					
S NO	TEAM NO.	TEAM LEADER	Last Month	Current Month	Next Mont Forecast	Last Month	Current Month	Next Mont Forecast	Last Month	Current Month	Next Mont Forecast	Last Month	Current Month	Next Mont Forecast	Last Month	Current Month	Next Mont Forecast	Last Month	Current Month	Next Mont Forecast
1	1RF1DO1	Kasmin	30	32	34	1	1	1	-	1	1	2	2	2	8	9	9.1	76	82	84
2	1FN1DO2	Maryono	29	31	32	-	1	1	-	1	2	2	2	2	8.5	8.7	8	59	66	72
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				

Prepared By :
(Internal Supplier)

Approved By :
(Internal Customer)

Table 3.9: QCDIP Chart (PT Elegant)

Example: Team Meeting Agenda (PT Indo Liberty):

The meeting schedule and place is fixed every month in advance. The typical agenda of the meeting is to discuss:

Number of Abnormalities identified in their area against forecast

Number of Kaizens prepared

Number of Problem solving tools used and their utility.

Number of One Point Lessons prepared

5-S score of their area in comparison to other areas

Number of systems simplified

Muda cases identified and removed

Autonomous Maintenance activity in their area

Internal customer satisfaction index and customer complaints, if any

Number of Major or minor accidents, their root cause and preventive measures

The teams identify abnormalities in their area. Their daily activities are translated in to SOP's and work instruction in their own language and are displayed in their area for daily use.

Systematic deployment of **Daily Work Management** practices by operating teams focusing on **QCDIP and Process forecasting, variability control** on individual values, **ZAM forecasting** has created a system of **Self Managed Workplaces**. Culture of Root Cause Analysis for any problem, Internal Warranties for any Breakdown, Due-diligence certificates for Muda free areas, Kaizen participation by teams etc. has become an integral part of day to day working.

Following tables and figures from PT Indo Liberty and PT Elegant are a few examples of the approaches being taken up.

(Refer CD-1, Exhibit 3.10, Team Performance PT Indo Liberty and PT Elegant)

Team Performance: (PT Indo Liberty)

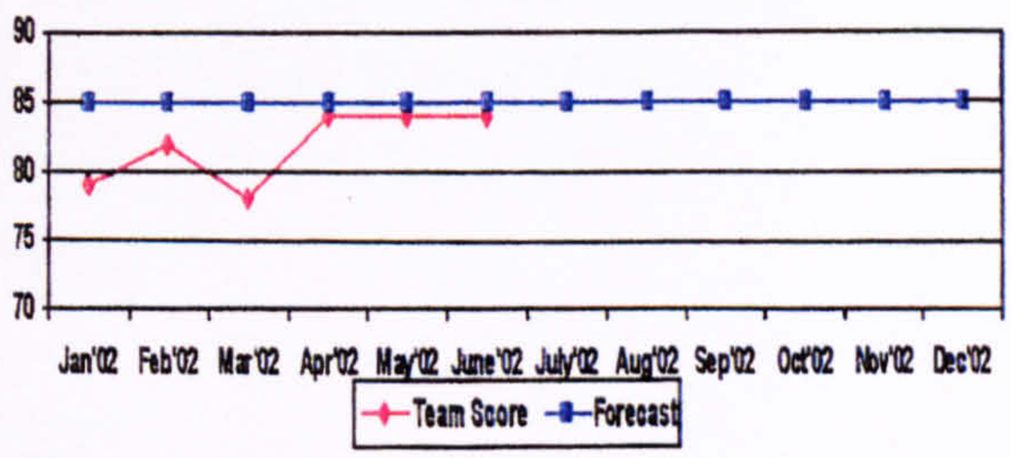
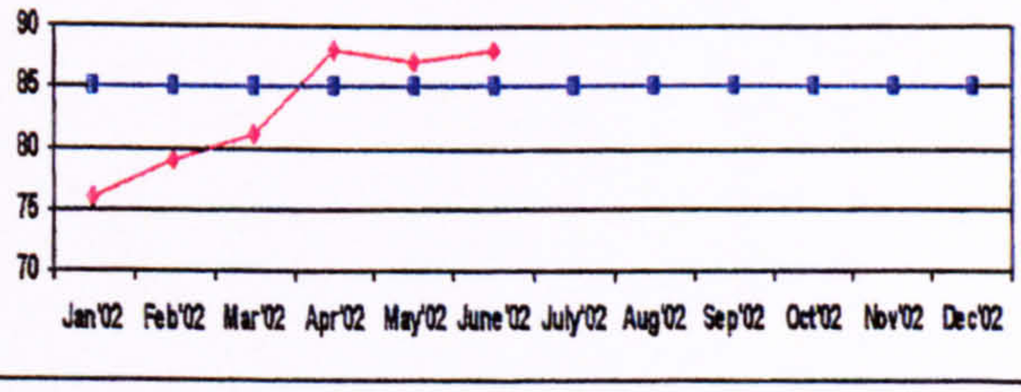
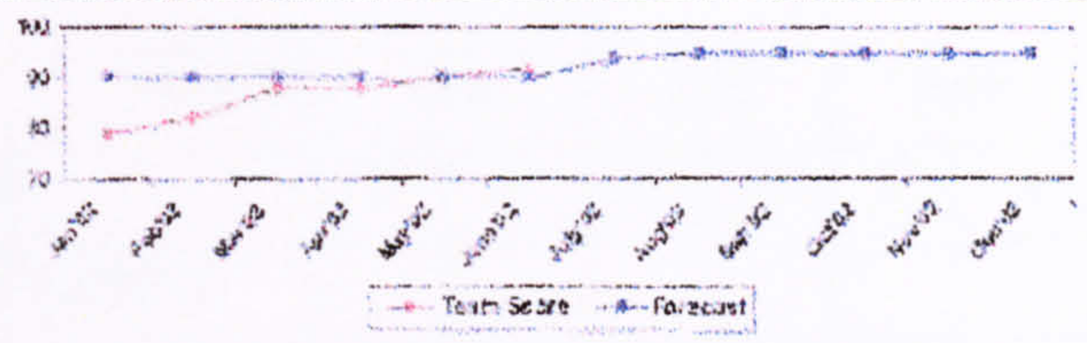
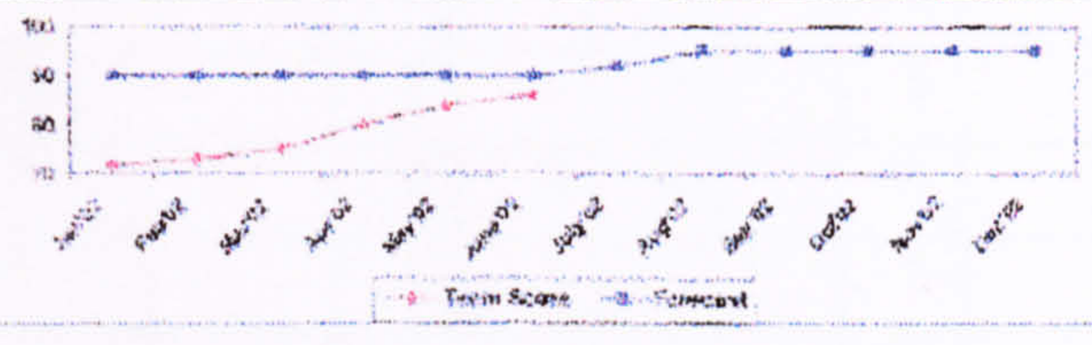
MONTH:	Jun-02				
Team No.	**Area/ Process**	**Customer**	**Team Leader**	**Actual for month**	**Monthwise Performance**
013G1	Blow Room to Simplex	Ring Frame	Mr.U.Singh	84	
023G1	Ring Frame	Winding	Aries Setiawan	88	

Fig 3.26: Team Performance (PT Indo Liberty)

Team Performance (PT Elegant, Indonesia)

MONTH: June '02

Team No.	Areal Process	Team Leader	Current Month	Forecasting next month	Monthwise Performance
1RFTD01	Ring Frame	Kasmir	92	94	
1FWTD02	Winding	Maryono	96	92	

Prepared by:
(Internal Supplier)

Approved by:
(Internal Customer)

Fig 3.27: Team Performance (PT Elegant)

ABNORMALITY FORECAST:

The Autonomous Manufacturing Teams Forecast for the next three months the eight types of abnormalities and three types of skills in their ownership area. The actual abnormalities detected in their area are compared with forecast. This helps them to be more aware of abnormalities and the efforts required to mange the work place.

Typical format of Abnormality forecasts are exhibited below:

(Refer CD-1, Exhibit 3.11A, Abnormality Forecast v/s Actual PT Indo Liberty and PT Elegant)

Zero Abnormality Movement

Area Preparatory **Team No: 011A1**

Forecast v/s Actual

Sr.No.	Month	June		July		Aug	
	Category of Abnormality	**F**	**A**	**F**	**A**	**F**	**A**
	CATEGORY A: PHYSICL (NO.)						
1	Minor Flaw	0	1	0		0	
2	Unfulfilled Basic Condition	0	0	0		0	
3	Inaccessible Places	0	0	0		0	
4	Contamination Sources	1	1	1		0	
5	Quality Defect Sources	0	0	0		0	
6	Unnecessary and Non-Urgent Items	1	0	1		1	
7	Unsafe Conditions	0	0	0		0	
8	Unsafe Practices	0	0	0		0	
	CATEGORY B: PROCESS (INDEX)						
1	Lack of Process Knowledge	18	15	15		13	
2	Application	80	82	84		86	
3	Up gradation	85	88	87		89	

Table 3.10: Abnormality Forecast vs. Actual (PT Indo Liberty)

PT ELEGANT TEXTILE INDUSTRY

Zero Abnormality Movement

Area: Mill - 1 Ring Frame

Team: 1RF1D01

Forecast v/s Actual

Sr.No	Month	June		July		Aug		Sep		Oct	
	Category of Abnormality	F	A	F	A	F	A	F	A	F	A
	CATEGORY A: PHYSICAL										
1	Miror Flaw	0	1	0		0		0		0	
2	Unfulfillec Basic Condition	0	0	0		0		0		0	
3	Inaccessessible P'aces	0	0	0		0		0		0	
4	Contam'nat on Sources	0	1	0		0		0		0	
5	Quality Defect Sources	0	1	0		0		0		0	
6	Unnecessary and Non-Urgent Items	0	0	0		0		0		0	
7	Unsafe Conditions	0	0	0		0		0		0	
8	Unsafe Practices	0	0	0		0		0		0	
	CATEGORY B: PROCESS KNOWLEDGE (INDEX)										
1	Lack of Process Knowledge	13%	13%	11%		9%		8%		7%	
2	Application	87%	87%	89%		91%		92%		93%	
3	Up cracation	2%	2%	2%		2%		1%		1%	

Preparec By

Leacer : Kasmin

Approved By

Sofyan M

Table 3.11: Abnormality Forecast vs. Actual (PT Elegant)

PROCESS FORECAST V/S ACTUAL VARIABLITY CONTROL:

The Teams are trained to develop mindset of controlling variation in every observation of process parameter rather than the control on average of daily parameters. The concept has been adopted as a part of daily work management in the format of P-D-C-A. The individual variation is analysed for root cause and proper action is taken to eliminate the root cause. The learning is displayed in machine and common boards for others to understand and apply the same in their respective area.

PT. ELEGANT TEXTILE INDUSTRY
MIII - 1

Process Forecast v/s Actual

Dept. : Ring Frame
Team No : IRF IDC1

	DESCRIPTION OF PROCESSES	IDEAL VALUE	Jun-02			Jul-02			Aug-02		
			FORECAST	ACTUAL	MARKS	FORECAST	ACTUAL	MARKS	FORECAST	ACTUAL	MARKS
Q	Quality Spinning : Count 30s TPR Un Evenness % 30s TPR Count CV %	30 ±0.6 83 +0.6 1.1 +0.3	30 ±0.6 84 ±0.4 1.0 ±0.2	30.4 85 1.17		30 ±0.5 83 ±0.4 0.95 ±0.2			30 ±0.6 83 ±0.4 0.95 ±0.2		
C	HOUR LOST DUE TO BREAK DOWN WASTE % (Ring)	0.04% 0.65%	0.03% 0.65%	0.02% 0.64%		0.02% 0.60%			0.02% 0.60%		
D	Delivery / day / Ring Frame 30s T/R (RX 240)	1600 lbs	1600lbs	1600lbs		1600 lbs			1600lbs		
E	KAIZEN	1/Month	1/Month	2/month		1/Month			1/month		
F	PRODUCTIVITY (RX240)	17,000 rpm	17,300 rpm	17,210 rpm		17,300 rpm			17,300 rpm		

Prepared By

Team Leader
Internal Supervisor

Approved By

Team Leader
Internal Customer

Table 3.12: Process Forecast v/s Actual (PT Elegant)

(The tables were prepared in Excel and have been scanned and reproduced for continuity of the subject. For clarity, the soft copy as Exhibit-3.9A, Exhibit-3.9B, Exhibit-3.10 and Exhibit-3.11A has been appended in CD-1)

Process Forecast v/s Actual

Sr.No.	Process	Indicators	Unit	May'02 Value	Range +/-	June'02		July'02		Aug'02	
						Forecast	Actual	Forecast	Actual	Forecast	Actual
1	BLOW ROOM	Q Quantity:									
		Fibre	Lbs.	72,500.00	1,000.00	71,300.00		72,000.00		72,000.00	
		Quality:									
		Blend Variation	%	0.55	0.02	0.53		0.52		0.52	
		C Cost:									
		Cleaning material	Rp./month	60,000.00	10,000.00	55,000.00		55,000.00		55,000.00	
		Spares	US$/100s pdl/shift	0.20	0.02	0.19		0.19		0.18	
		D Delivery									
		Fibre	Sec	10.00	1.50	10.00		10.00		10.00	
		I Innovation:									
		Kaizens	Nos.	5.00	2.00	6.00		7.00		8.00	
		P Productivity:									
		OEE	%	96.42	0.05	96.45		96.47		96.48	
2	CARDING	Q Quantity:									
		Sliver	Lbs.	72,500.00	1,000.00	71,300.00		72,000.00		72,000.00	
		Quality:									
		CV %	%	0.85	0.02	0.82		0.80		0.80	
		C Cost:									
		Cleaning material	Rp./month	90,000.00	10,000.00	85,000.00		80,000.00		75,000.00	
		Spares	US$/100s pdl/shift	1.00	0.02	0.98		0.97		0.97	
		D Delivery									
		Sliver	Mins.	40.00	2.00	40.00		40.00		40.00	
		Speed	m/min	89.00	1.00	89.00		89.00		89.00	
		I Innovation:									
		Kaizens	Nos.	8.00	2.00	9.00		10.00		12.00	
		P Productivity:									
3	DRAW FRAME	Q Quantity:									
		Sliver	lbs	72,500.00	1,500.00	71,300.00		72,000.00		72,000.00	
		Quality:									
		Cv % Ry	%	0.16	0.01	0.16		0.16		0.16	
		Cv % TR	%	0.20	0.01	0.18		0.16		0.16	
		C Cost:									
		Cleaning material	Rp./month	65,000.00	10,000.00	60,000.00		60,000.00		55,000.00	
		Spares	US$/100s pdl/shift	0.80	0.02	0.80		0.78		0.77	
		D Delivery									
		Sliver	mins	16.00	1.00	16.00		16.00		16.00	
		Speed	m/min	600.00	50.00	600.00		600.00		600.00	
		I Innovation:									
		Kaizens	No.	6.00	2.00	7.00		8.00		9.00	
		P Productivity:									

Table 3.13: Process Forecast (PT Indo Liberty)

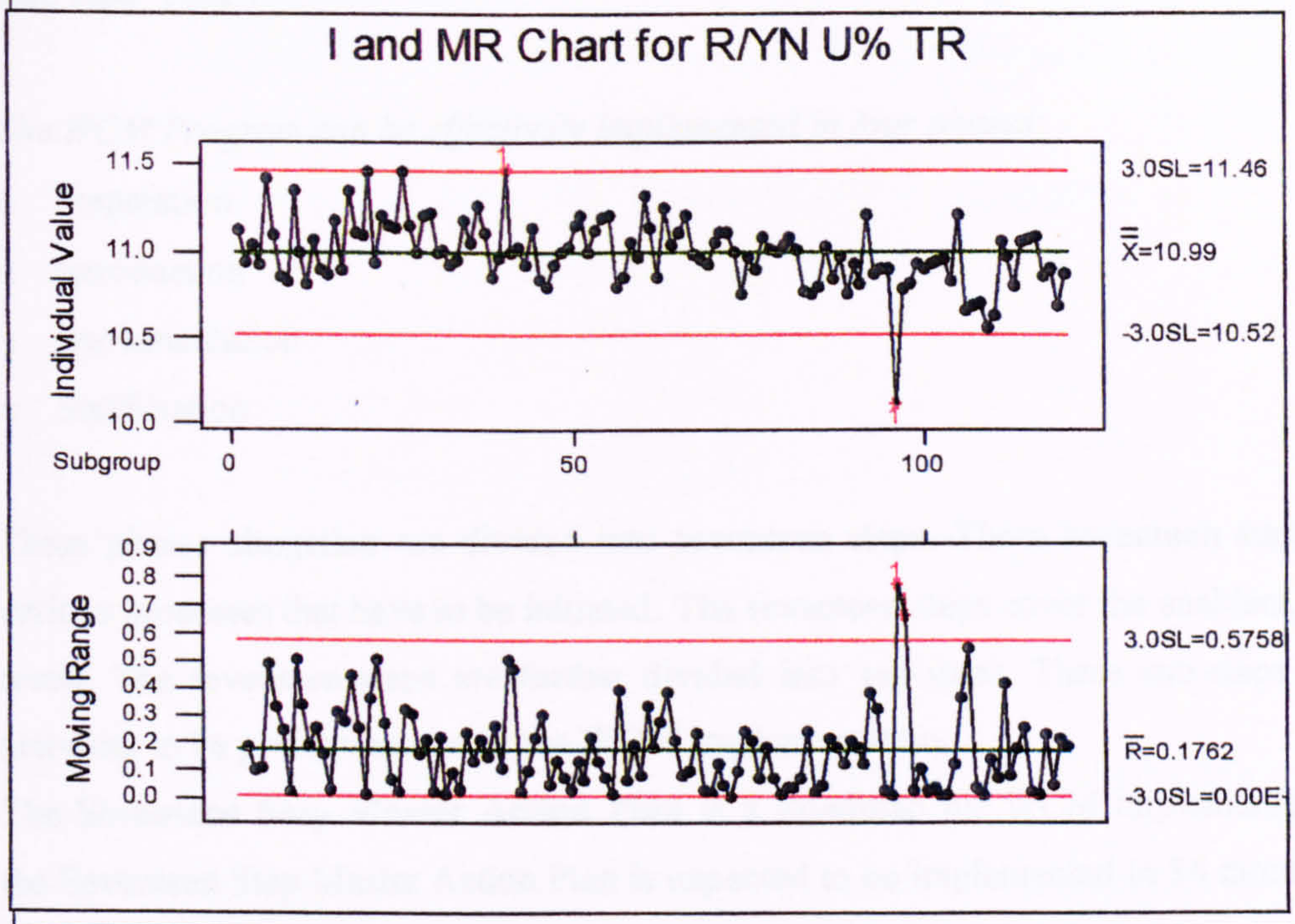


Fig 3.28: Variation Control Chart (PT Indo Liberty)

(Refer CD-1, Exhibit-3.11B, Example for Variability Control PT Indo Liberty)

3.5.2 Roadmap to WCM: Seventeen Steps Master Action Plan

"If you don't know where you are going, you might end-up somewhere else." (Refer book: Creech

Bill (1994), *The Five Pillars of TQM – How to Make Total Quality Management Work For You,*

Truman Talley Books Plum Penguin Group, New York.)

"*Write it down. Written goals have a way of transforming wishes into wants, cant's into cans, and plans into reality. Don't just think it---ink it*" (Refer book: Harrington H James, Lomax

Kenneth C (1999), *Performance Improvement Methods-Fighting the War on Waste,* McGraw-Hill, New York.)

The WCM Program can be effectively implemented in four phases:

- Preparation
- Introduction
- Implementation
- Stabilisation

These phases altogether are divided into seventeen steps. These seventeen steps define the various processes that have to be initiated. The seventeen steps cover the enablers, process and result. The seventeen steps are further divided into sub-steps. These sub-steps a rea set of activities to be performed during the WCM implementation.

The **Seventeen Step Master Action Plan** is a Roadmap for WCM implementation. Ideally the Seventeen Step Master Action Plan is expected to be implemented in 36 months. The Unit WCM Secretariat in consultation with the Sub-Committees and the Steering Committee prepares the Seventeen Step Master Action Plan. The Steering committee reviews the same every month, and initiates necessary action.

The Master Action Plan helps Unit in the planning their activities and then monitoring them continuously.

The Seventeen Steps are:

1. Building Management Will, Mindset, Culture and Leadership and announcement by Top Management.
2. Forming the Teams and Facilitating Structure, establishing common WCM language, establishing ownership and developing a detailed Master Action Plan for goals to be achieved.
3. Preparing the Self Competing Teams
4. Competition- The Olympics and Visual Management
5. Setting up the Model Area/ Equipment
6. Work Environment and Waste Elimination
7. Focussed Improvement
8. Planned Maintenance
9. Autonomous Maintenance

10. MP Design, Initial Flow Control/Upstream Management
11. Quality First: Strategic Quality Management and Best Practices
12. Market Orientation and Customer Driven: Internal and External; Liaison, Team Force and Skills Development
13. JIT, Stock Reduction, Material Handling and Logistics
14. Safety, Hygiene and Pollution Control
15. Information, Systems, Technology, Cash Flows and World Class Office Management
16. Measuring and Monitoring Results
17. Preparations and Achievement of Chairman's Awards for Manufacturing Excellence

(Refer CD-1, Exhibit-3.12, Seventeen Step Master Action Plan)

Brief Explanation of Each of the 17 Steps and Their Sub-Steps

Step 1A: Building Management Will, Mindset, Culture and Leadership

Sub Step 1: WCM Conference cum Workshop for Champions:

For the inspirational part, the WCM Conference cum Workshop has exceptional potential and acts as **stimulus to the Cultural Change.** ***The Conference cum Workshop*** is a sophisticated model, wherein organisation abandons the traditional demarcation between managers and the managed and instead recognises that all employees will need to assume some managerial responsibility. The participants of the first Conference cum Workshop in any organization opting for implementation of WCM are so chosen that they are representative of the entire company. They constitute approximately 10% of the entire workforce selected across all layers of the organization (this includes the Chief Executive Officer, representatives of Top Management, Middle management, Junior management, Engineers, Union Leaders and Workers). The very fact that the Organisation has agreed for such a structure in a positive indication of its commitment towards Building Management Will, Mindset, Culture and Leadership.

Process of Conference cum Workshop: The Corporate WCM Cell conducts a Two Days Conference cum Workshop in each Unit to initiate the WCM Activities aiming towards Zero Abnormality Culture.

The Conference cum Workshop has to be attended by at least 10% of the total number of employees with the minimum strength of 40. The participants cover a cross section of

employees including the CEO, Senior Personnel, Middle Management, Representatives from Workers, Union Members and Staff

Through conference-cum-workshop the concept and knowledge is imparted. The participants are exposed to shop floor training to transform themselves as *Champions of Change* for proliferating the World Class Manufacturing concepts to all level through in-house conference cum workshop. *The profile of the participants is such chosen that they represent all hierarchical layers. These participants having agreed to work together in a team is itself an indication of the Organization's Positive Mindset towards Change. Having participated in a Change Management Workshop as previously referred, automatically gives them an identity of "Champions of Change."*

The Conference cum Workshop is divided into two Sessions:

The First Day Sessions:

The *First Session* of *First Day* begins with the Welcome Address by the unit CEO. It is followed by opening remarks by the Speaker and the Video Projection of Chairman's Speech and WCM Theme Song. The presentation by the Speaker covers the basic Concept of WCM including Mindset, Culture, and Leadership.

The study material to be given to the participants for a particular Session is placed on their tables before the commencement of that Session.

The teams carry out exercises on the following topics:

1. Abnormality Identification (Zero Abnormality Movement)
2. Waste Identification
3. One Point Lesson
4. What If Exercise

The teams are provided with detailed guidelines and formats to help in carrying out the exercise, to be followed by presentation.

One guide belonging to that area accompanies the Team in order to clear their doubts about the equipment conditions etc. Participants are required to identify various abnormalities according to the Eight Types of Abnormalities. These observations are filled in the Zero Abnormality Movement Format.

The Second Day Sessions:

The presentation is made in the presence of the CEO. An Action Plan is prepared for rectification of the Abnormalities and Waste identified during the Conference cum Workshop.

Sub Step 2: In –house Conference cum Workshop:

To cover rest of the employees a series of in–house Conference cum Workshops are conducted by the WCM Secretariat with the help of *Champions* developed during the Conference cum Workshop conducted by Corporate WCM Cell. This program is a replica of the Conference and Workshop conducted by Corporate WCM. Records of these Workshops are to be kept ready with the WCM Secretariat.

Sub Step 3: Teams to Revisit the Same Area:

The teams formed during the Conference cum Workshop identify the Abnormalities and prepare an action plan for the Abnormality rectification. These teams take the responsibility of the follow up actions. In this regard the teams revisit the areas where they had been sent for abnormality identification and ensure that those abnormalities have been rectified. The frequency of revisit is once in a month at least.

"A Team brings together different individuals who know and can do different things. It is a means of pooling and using the diverse 'knowledge' and skills of its members to accomplish mutual goals." (Refer book: Mankin Don, Cohen.G. Susan, Bikson K. Tora (1996), Teams & Technology – Fulfilling the promise of the New Organization, Harvard Business School Press.)

Sub Step 4: Top Management Leading by Setting Examples

Step 1 B Announcement by the Top Management

The Top Management makes an announcement regarding the launching of WCM initiatives in an open forum where all the employees are present. The purpose of this activity is to make the employee feel the need of WCM initiatives and to align them with the vision of the company. The message is also published in the Company's Bulletin and/ or the local newspaper. Proper coverage with photograph is essential. This helps in boosting the motivation level of the employees and an acknowledgement of the commitment of the management.

Step 2A: Forming the Multi Skilled/Cross Functional Teams and Facilitating Structure

It covers the following sub-steps:

Sub Step 1: Steering Committee

Sub Step 2: Working/ Sub Committees on KMFA

Sub Step 3: WCM Secretariat

Sub Step 4: Operating and Project Teams

Step 2B: Establishing Common WCM Language

- Common WCM language means total alignment of all employees in the concepts and practice of WCM initiatives. The several key words mean the same to every employee irrespective of the location. The understanding is uniform

Step 2C: Establish Ownership

The teams work on the principle of "This is our area and our equipment and we together maintain it". So the area/equipment ownership is assigned to the respective teams and these teams in turn take care of their area/ equipment by practicing all the dimensions of WCM.

Step 2D: Develop Detailed Master Action Plan

A detailed Seventeen Step Master Action Plan for thirty-six months is prepared by the Organisation after the launch of WCM. This Action Plan is prepared only after a detailed discussion with the Sub Committees and the Steering Committee. Based on this Master Action Plan individual sub-committees prepare their Action Plans.

Step 3A: Equip the Teams with Values & Mindset

Sub Step 1: Equip the Teams with the Mindset that Rejects Abnormalities in any Form and Pays Attention to Details:

The teams are trained through a workshop where abnormality identification is taken as the key task. The teams are provided with the structured eight types of abnormalities to facilitate the process of identification of abnormalities.

Step 3B: Train the Teams on Problem Solving Tools:

Sub Step 1: Train the Teams on 5 Why's (Why-Why Analysis), 7QC Tools, PM Analysis, PDCA, IE Techniques, Value Engineering, and FMEA:

The training is imparted to team leaders to begin with who in turn train the members. Each tool is explained with examples and participants are asked to use each tool in the training program to obtain deep understanding. Thereafter the teams use the tools in Problem solving in their ownership areas. The duration of these training modules vary according to the nature of the problem-solving tool. *For example; Why-Why Analysis may require only one day of training whereas* ***a tool like PM Analysis requires three days of training with revisits later on.*** **(Refer CD-1, Exibit-3.13,** Table of Training)

Sub Step 2: Train the Trainers/ Team Leaders on Leadership & Communication Skills

Units train the Trainers and Team Leaders on Leadership and Communication Skills because the success of teams is very much dependent on these Trainers and Team Leaders who are responsible to lead and train all the employees/ team members through relay training.

Step 3C: Initiation of WCM Campaigns by all the teams in all the Areas:

The Organization launches the following Campaigns in all the areas:

- Know Your Equipment
- Initial Cleaning
- Why-Why Analysis
- Visual Controls
- Simplify the Systems
- Standardization of Lubricants
- Internal Warranty Systems
- Halve Your Losses/ Defects
- Double the Productivity
- Reduce Working Capital

The above campaigns are displayed and followed by all the teams.

Step 3D: Mission Statement and QCDIP Expectations for Internal Customers

Sub Step 1: Set Mission Statement for all the teams:

Every team prepares a Mission statement in which it outlines in brief what it strives to achieve within a given frame. The Mission is in line with the Vision of the organisation.

Sub Step 2: Set QCDIP of all the teams:

Since every team plays a triple role – Customer, Processor & Supplier therefore the QCDIP is very important for all the teams. The QCDIP is based on the Customer expectations and prepared in consultation with them.

(This paragraph has also been referred earlier in the same chapter. This is because of the fact that this particular step is also forms a part of the second main step of WCM implementation methodology, i.e. Equipping the Teams. Since at present the step by step explanation of the seventeen step implementation master action plan is being described here it becomes imperative to refer to this paragraph again and again)

Step 3E: WCM Kick Off

The objective of 'WCM Kick Off' ceremony is to make a public declaration of its commitment to implement WCM initiatives. Therefore the Organisation is expected to conduct a WCM Kick Off ceremony. The Kick Off ceremony is a function where apart from the internal employees the external agencies i.e. Suppliers, Customers, Affiliated Companies, Business Associates and other related organizations are called up for launching of the WCM concept. The associated organisations are made aware of the fact that the Organisation is now going for a Cultural Transformation.

Step 4: Competition: The Olympics, and Visual Management

Sub Step 1: Visual Display of WCM Vision, Mission and Policy Statement at Appropriate Places in the Factory:

The Organisation prepares a Vision, Mission and Policy Statement, which is appropriately shared with everyone in the organization. Everyone understands the Vision, Mission and Policy and the organization ensures that these are integrated into all its Action Plans. These displays are placed in all the areas. The idea is to make the employees aware of the Vision, Mission and Policy statements. Along with other communication measures to facilitate understanding, the display serves as constant reminder to everyone.

Sub Step 2: Plant Boards Depicting Ownership Details:

The Plant Board is a Powerful Visual Display of the ownership areas of various teams and is an excellent medium of communication and alignment.

Sub Step 3. Abnormality Management Board in all the Zones Areas:

Abnormality Management Boards is located at appropriate locations with prominent visibility. The important aspect is the participation of every employee right from CEO down to last employee in the process of abnormality identification. The boards should be updated.

Sub Step 4. Compliance Confirmation of SOPs at Appropriate Places:

The Compliance confirmation board for Standard Operating Procedures are displayed at all the equipment. The Standard Operating Procedures are prepared in consultation of all the Team members, the Production, Quality and Maintenance Department in order to have a detailed and accurate SOP. The Board consists of columns with divisions for shift, where concerned employee with a tick mark indicates the completion of specified activity. The Board also serves as a Visual control. Such a board is placed near all key processes.

Sub Step 5: Process Performance Board:

Sub Step 6. QCDIP Board:

Sub Step.7. Display of Kaizen themes

Sub Step 8: Display of One Point Lessons Boards in the Team Meeting:

Sub Step 9: Display Emergency Handling Procedures:

Sub Step 10: Display the Slogans at all Important Places in the Factory:

Sub Step 11: Monitoring of all Visual Management Boards and Display the Minutes of the Team Meetings:

There is a very clear procedure for monitoring the Abnormality Management, SOP, QCDIP, Process Performance Boards etc. All these boards come under the menu of "Visual Competition." The organisations choose from this "list", those competitions which they find to be effective in their respective organisations. **(Refer CD-1, Exhibit-3.14,** Menu of Competition)

A list of all boards is prepared along with a monitoring schedule. The sub-committee and the WCM secretariat members regularly visit the areas as per the schedule to check progress and

conduct audits. **(Refer CD-1, Exhibit-3.15,** Monitoring Schedule)

Step 5: Setting up the Model Equipment/ Area:

In the process of initiating a change in the culture, it is a proven approach to focus initially in smaller Area/ Equipment, which is termed as Model Area/ Equipment. Senior management who actually takes hands on responsibility for improvement adopts the Model Area. These Model equipment/ areas are made totally abnormality free.

Identify the Model Equipment/Areas:

At least 10% of the total equipment/areas in case of an Old Plant and much more in a New Plant (invariably critical equipment is around 10% of the total equipment, so therefore model area activity is initiated first with the critical equipment and then gradually this activity is replicated to all the other equipment). **(Refer CD-1, Exhibit-3.16,** Model Equipment Standards)

The Model Area Team(s) are fully equipped with concepts, tools and techniques through appropriate training/workshop. A detailed action plan for implementing all the Eight Dimensions is made. It is very important for the Model Area to show quantum improvements and serve as role model for rest of the Unit.

The Model Area has the following displays:

- Process Performance Board
- QCDIP Board
- Abnormality Management Board
- Team Board with Names, Mission, Minutes of the Meeting etc.
- Kaizens Themes
- One Point Lesson
- SOP (Standard Operating Procedure)
- WCM Slogans
- All the results of the Model Area such as OTIF, Internal Customer Satisfaction Level, MTTR, MTBF, OEE, 5S Scores, and Stocks etc. is measured, monitored, targeted and visually presented.

Monitoring the Result of the Model Equipment/ Areas:

These model equipment/ areas are supposed to be the benchmark for the rest ones For measuring the results, various audit sheets are used. Results are displayed near the model equipment/ Areas.

Step 6A: Work Environment (5S)

Sub Step 1-Segregation (1S)

Sub Step 2-Neatness (2S)

Sub Step 3-Cleaning (3S)

Sub Step 4–Standardization (4S)

Sub Step 5–Discipline (5S)

Self Audits

In each of the step, the teams periodically carry out audits as per prescribed audit sheets and assign scores. Target for improvement are evolved for teams, which also serves as a point of competition amongst the teams. Along with this Sub Committee/ Steering Committee carries out external audits.

Step 6B: Waste (Muda) Elimination

Sub Step 1: Identification and Elimination of Waste:

Waste is identified under all the *Twelve Categories* and all the identified waste are removed with proper action plan.

Sub Step 2: Practice the concepts of value management:

Operating teams also evaluate and assess all other activities related to business operations, whether they are adding to any functional value or not. Process Mapping is very appropriate tool. **(Refer CD-1, Exhibit-3.8,** Process Mapping)

Sub Step 3: Practice ZAM (Zero Abnormality Movement)

ZAM covers all the areas and equipment.

Step 7: Focused Improvement and Kaizen

Sub Step 1: Identification and Categorisation of Losses from all the Areas and all the

Equipment:

Each operating team is trained to identify every category of loss with respect to every machine in their area of ownership.

A calculation of losses for all equipment, assembly lines plant gives a true indication of effectiveness of capacity utilisation.

Sub Step 2: Reduction of Losses and Raising the OEE of the Equipment:

The following steps are followed for *Systematic Reduction of Losses* through small group activities, which ultimately results into increased OEE:

1. Preparation for Improvement
2. An Improvement Topic is selected
3. Abnormalities are exposed
4. Causes are analysed
5. Improvements are planned
6. Implementing Improvement
7. Results are checked
8. Gains are consolidated

Sub Step 3: Measuring the OEE for All Critical Equipment:

The OEE is measured for all the equipment individually beginning with the critical equipment. The operating teams measure and monitor OEE for the equipment in their ownership area.

Sub Step 4: Deployment of Kaizen Themes:

The Organisation initiates the Kaizen suggestion Scheme in all the areas. The sub-committee scrutinisees the Kaizen proposals suggested by the Teams.

Sub Step 5: Preparation of a List of Sporadic and Chronic Losses:

The Sub-Committee in consultation with all the teams, prepares a list of Sporadic and Chronic Losses.

Sub Step 6: Use of Why-Why Analysis, Brain Storming and other QC Tools to Eliminate Losses:

The teams are guided to use the various techniques such as Why-Why Analysis, Brain

Storming and QC Tools in analysis of problems and development of solutions.

Sub Step 7: Use of PM Analysis in all the Areas to Eliminate Chronic Losses:

All the teams are trained on the concept and application of PM Analysis to eliminate all the chronic losses.

Sub Step 8: Measure and Optimise Energy Consumption Levels:

The organisation measures the current Energy (all forms of energy) Consumption and Plans a target for reduction in energy consumption levels.

Step 8: Planned Maintenance

Sub Step 1: Preparation of History Cards for All the Equipment:

The History cards are to be displayed on the equipment.

Sub Step 2: Tracking of Inventory of Spare Parts and Tools:

Planning of spare parts and tools is an essential requirement.

Sub Step 3: Formulate and Implement Equipment Evaluation Standards:

To decide which equipment receives Planned Maintenance, equipment logs are prepared and equipment are prioritised in accordance with the pre-established criteria.

Sub Step 4: Analyse the Number of Failures and Set Maintenance Goals:

To grasp the current situation following activities are conducted:

1. Obtain data on failure numbers
2. Frequencies of failures
3. Severity of failures
4. Mean time between failures (MTBF).
5. Mean time to repair (MTTR)
6. Maintenance costs

Sub Step 5: Correct Weaknesses and Restore Deterioration through Kaizen:

Support of Maintenance is required for Self Maintenance activities in restoring the accelerated deterioration, correcting weaknesses, and restoring the optimal equipment conditions.

Sub Step 6: Training of Operators on Daily Maintenance Activities:

The Sub-committee for Planned Maintenance arranges for the training of operators on daily maintenance activities.

Sub Step 7: Use of Why-Why Analysis and Other Problem Solving Tools for Eliminating the Breakdowns:

Every breakdown is supported with the Why-Why Analysis or other problem solving tools to identify the root cause. The Sub-committee helps all the teams to inculcate a culture where every problem/ breakdown is reported with a support of Root Cause analysis.

Sub Step 8: FMEA and other Tools to Deal with Major and Intermediate Failures:

FMEA is used effectively as a Risk Assessment Tool

Sub Step 9: Conduct PM Analysis to Eliminate Chronic Failures:

Phenomenon Mechanism Analysis is used as a Problem Solving Methodology to eliminate those failures whose cause and effect relationship cannot be obtained through the application of simple problem solving tools.

Sub Step 10: Establish Failure Data Management System:

A Failure Data Management System includes certain information, which shift operator enters in the database. Such information includes date and time; failure rank (major, intermediate, and minor); equipment model; failed component; nature of failure; effect on production; time and the number of personnels required.

Sub Step 11: Installing Computer Aided Maintenance Management System:

For efficient and effective Planned Maintenance the organization installs a Computer Aided Maintenance Management System (CAMMS). CAMMS is integrated with the existing planned maintenance system. The entire data on failures, inventory levels, maintenance costs data, spare parts details are keyed into the CAMMS. This system is utilised as a comprehensive database. It is also used for generating reports, inventory management, spare parts management, generation of work orders, re-order of maintenance spares, maintenance cost budgeting.

Sub Step 12: Introduce Periodic (Time based) Maintenance System:

Following procedure is adopted for Introducing Periodic (Time based) Maintenance System:

1. Select equipment for periodic maintenance
2. Prepare Periodic Maintenance manuals and check sheets
3. Determine Maintenance Work and Interval:

- o Material Selection Standards
- o Work Estimation Standards
- o Spare Parts Control Standards
- o Lubrication Control Standards
- o Lubrication- Supply Control Standards
- o Safety Standards

4. Prepare for Periodic Maintenance
5. Perform Periodic Maintenance
6. Prepare story
7. Add to Equipment History and File

Sub Step 13: Build Predictive Maintenance Management System:

Introduce Equipment Diagnostics: Predictive Maintenance involves the use of equipment diagnostics.

Sub Step 14: Use of Diagnostic Tools for NDT and Monitoring all the incoming material and condition of all the Equipment:

The diagnostic tools such as Vibration meters, Spectrometer, X Ray analysers, Wear Debris analysis etc (whatever applicable) for the incoming material as well as for the condition of all the equipments are used in order to prevent the occurrence of defects and failures.

Sub Step 15: Measuring MTTR and MTBF for all Critical Equipment:

The Critical equipment (ranked A) should perform at its highest effectiveness. Therefore the MTTR and MTBF of this equipment are calculated in order to identify the scope for improvement and enhanced OEE.

Sub Step 16: Reduction in MTTR and Increase in MTBF:

The Critical Equipment and Machineries directly affecting the production/productivity of plant are identified and their MTTR & MTBF are computed/recorded

Sub Step 17: Use of RCM for All Critical Equipment:

It helps answering the questions like:

How the item can fail to fulfil its functions?

What can cause each possible loss of function?

Sub Step 18: Budgeting and Monitoring the Maintenance Cost:

This includes budgeting and monitoring of Breakdown cost, Manpower cost, Overhead cost, Material Handling cost, Depreciation cost, Interest on capital.

Sub Step 19: Practice Internal Warranty System:

In this system a card is used, which contains a warranty statement given by the Maintenance department indicating that the machine repair has been performed well, the machine will continue to run for a definite period as warranted by maintenance without failure provided that the operator maintains the daily checking activities.

Sub Step 20: Audit the Planned Maintenance System:

The Sub-committee arranges for a Periodic Audit for each of the steps of Planned Maintenance.

Sub Step 21: Provide Feedback on Corrective Maintenance on All the Equipment for MP Design:

The detailed feedback on any of the corrective maintenance/modification made in the basic design is given to the R and D through the Initial flow Control Sub-Committee for record and reference.

Step 9: Self Maintenance

Sub Step 1: Allocation of Responsibilities of Maintenance and Operations Department:

In the development of Self Maintenance it is important to classify and allocate the responsibilities of Operations and Maintenance department specifically.

The Operations Department focuses on preventing deterioration.

Maintenance Department puts its efforts into planned maintenance, predictive maintenance and corrective maintenance, concentrating mainly on measuring and restoring deterioration.

Sub Step 2: Perform Initial Cleaning of all the Main Equipment and Sub-equipment:

Initial cleaning is '*the thorough cleaning*' performed to expose and eliminate all the basic abnormalities.

Sub Step3: Impart Training to all Operators on the Construction and Functions of the machine they handle:

For training as well as for daily reference, the following are prepared and displayed for effective impact:-

Know Your Equipment Campaigns

One Point Lesson

Dos and Don'ts

Brief Write Up of Machine

Each and every operator must also learn the following specific skills:

The ability to improve one's own capability to discover equipment abnormalities

The ability to understand the structural functions of the equipment to discover the factors that give rise to abnormalities

The ability to understand the relationship between equipment and the products they make and to predict the occurrence of quality abnormalities

The ability to take the necessary safety precautions

Sub Step4: Identification and Modification in Inaccessible Places:

The purpose of identifying and eliminating inaccessible places is to reduce the time taken for cleaning, checking and lubricating.

Sub Step 5: Prepare Inspection Schedules for all the Equipment:

Proper inspection schedule for each and every equipment with proper frequency and timing.

Sub Step 6: Impart Training to Operators on Inspection based on Inspection Manual:

The purpose of this step is to develop equipment competent operators who can detect malfunctions and recognise them as the first symptom of breakdown.

Sub Step 7: Prepare Cleaning and Inspection Standards for all Equipment:

The goal is to put in place a set of standards that can maintain and improve upon the condition of the equipment.

Sub Step 8: Monitor Cleaning and Inspection Standards for all the Equipment in all the areas

Inspection is simplified through Visual Control.

Sub Step 9: Develop Lubrication Standards for all the Equipment:

Lubrication standards are developed in the same way as cleaning and inspection standards

Sub Step 10: Develop Colour Codes for all Lubricants:

Colour codes are assigned to all the lubricants for avoiding confusion.

Sub Step 11: Define Checkpoints for Lubrication and Tightening for all the Equipment:

For avoiding the confusion and ease of operation all the checkpoints are marked with the respective lubricant's colour code facilitating inspection and tightening etc.

Sub Step 12: Place Cleaning Checklist on or Close to all Equipment in all Areas:

The checklists are prepared for all the equipment and placed on or near the respective equipment itself.

Sub Step 13: An Effective Self Management for Material Flow, Spares Tools, WIP etc:

The operating teams are empowered enough for self management of their work place and day to day needs. A system is put in place by which the teams can themselves manage their requirement of spares, materials, tools etc.

Step 10: Initial Flow Control/ Upstream Management, MP Design

Sub Step 1: Meeting with Equipment Manufacturers for all the Critical Equipment:

Effective communication of the design requirement is ensured during the meetings with equipment manufacturer of all the critical equipment. In such meetings, key personnel from Unit (Production and Maintenance Engineers) as well as equipment manufacturing company are present

Sub Step 2: Effective System for Maintenance Prevention for all Equipment:

MP Design adopts a "Human-Machine" System approach to design problem-free, safe equipment that makes quality assurance easy. When conducting MP Design, following basic

attributes that equipment must possess are addressed; Reliability, General Maintainability, Operator Maintainability, Operability, Resource Economy, Safety, and so on.

Upstream Management System Comprises of:

Outline Planning

Action Planning

Design

Fabrication

Witnessed trial Operation

Installation and Commissioning

Sub Step 3: Design Data Collection and Review for Improvement:

Design data collection and review of the same for improvement is essential to standardize and feed back to in-house and outside information on factors such as quality requirements, production technology, maintenance, and safety. Such system ensures that all information is incorporated into check sheets, design standards, and other documentation.

Sub Step 4: Calculate LCC and Review for all Equipment:

Decision taking for replacement of an equipment or facility after certain period is greatly influenced by its Life Cycle Cost.

LCC can be used for assessing new technology also.

LCC is calculated for all equipment periodically.

Sub Step 5: MP Design and Initial Control Sheets for all Critical and New Equipment:

The sheets are prepared for all critical and new equipment.

Sub Step 6: Perform FMEA and PM Analysis for Critical Equipment in case of Failures of Equipment:

Step 11: Quality First: Strategic Quality Management

Sub Step 1: Benchmarking:

Benchmarking exercise is done all across the industries worldwide.

Sub Step 2: Certification of ISO 9000/ QS 9000 and Periodic Internal Audits/ Surveillance:

The Organisation trying to achieve ISO 9000/QS 9000 are to have a clear documented Quality Procedures.

Sub Step 3: Preparation of Quality Plans for all the Manufacturing Processes covering all the Parameters of the Product and the Process:

Quality Plans, along with the Production Plans, are primarily documented on the work order (although they can be separate documents). The work order lists all production steps and inspection points, and references drawings, specifications, procedures, instruction required for production and inspection.

Sub Step 4: Implement SQC to analyse variation in Product Quality at all stages:

For incoming raw material, process and product SQC (Strategic Quality Control) Tools e.g. Acceptance sampling, Standard Sampling plans, Design of Experiment, Flow charts, Check sheets, Histograms, Pareto charts, Scatter diagrams, Cause and Effect analysis are implemented.

. **(Refer CD-1, Exhibit-3.5,** Six Sigma Project Report)

"*The idea behind SQC is continuous improvement in processes, based on data.*" (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

The guidelines for SQC are as follows:

Map the process

Identify the characteristics critical to quality variation

Select the appropriate tool of SQC

Implement the technique

Measure and monitor

Sub step 5: Implement SPC to Measure and Monitor the Process Capability, Maintain the Process Capability Index at the Optimum Level:

Process variation is controlled through the application of SPC (Statistical Process Control) Techniques.

Sub Step 6: Identification of Non-Conformities at all Stages of Process from all the Equipment

The teams, which are the owner of their respective areas, spare at least 10-20 minutes during their duty for carrying out abnormality identification religiously every day.

Sub Step 7: Investigate the Actual State of Quality, Operating Conditions and Machine Conditions for all the Non- conformities Identified from all the Equipment:

Thorough analysis of the problem is done for all the non-conformities identified and the actual state of Quality, Machine condition and operating condition is traced

The non-conformities for the machine condition can be worn out parts, excess vibration, due to looseness. Operating conditions can be insufficient lubrication, reduced rpm, insufficient pressure, inadequate temperature, etc.

Sub Step 8: Use Basic Problem Solving Tools:

The unit proliferates a culture where all the problems are solved by the teams using the basic problem solving tools viz. Why-Why Analysis, Cause and Effect Diagram etc. *The essential thrust of improvement activities in World-Class Manufacturing is on identifying the root cause of an undesirable occurrence, and taking steps to ensure that the cause is eliminated.* **(Refer CD-1, Exhibit-3.17,** Case Study of QC Tools at Raja Shree Cement)

Sub Step 9: Analyse the Effect of 4M for all the Non-conformities Identified:

This involves the analysis of the effect and establishing the correlation between Man, Machine, Method and Material for the identified non-conformity/abnormality.

Sub Step 10: Use PM Analysis to Eliminate Chronic Defects for SQM:

Phenomenon Mechanism Analysis is a unique, detailed, systematic and an extremely comprehensive problem solving methodology used for the analysis and arriving at the root cause of chronic defects and problems (whether related to process or machine). **(Refer CD-1, Exhibit-3.18,** Examples on Phenomenon Mechanism Analysis)

Sub Step 11: Continuous Improvement in Checking Methods:

Continuous improvement in checking refers to efforts made for increasing the accuracy for defect prevention and reducing the time spent for checking/ inspection. The ultimate goal is to reduce or eliminate the need of checking/inspection.

Sub Step 12: Status of Zero Customer complaint:

With a focus on Customer continuous efforts are made in order to reduce Customer Complaints to zero level and sustain the same.

Sub Step 13: Develop Poka Yoke System for Avoiding Human Error:

Poka Yoke systems regulate and control the production process and prevent defect.

Sub Step 14; Long Term Contractual Relationship with the Suppliers to minimize variability in Quality:

In order to ensure the consistency in the material and OTIF delivery long-term relationship is to be established with the suppliers. This not only reduced total process cycle but also led to decrease in the inventory levels of the organisation.

Sub Step 15: Implementation of QFD (Quality Function Deployment):

Quality function deployment (QFD) or the house of quality is a planning tool used to give direction on what should be done to meet the needs of the customer. It has also been effectively used as a communication tool so that product definition and efforts have direct focus towards the needs of the customers. A typical example of QFD is supplemented ahead for a 'Safety Belt' showing the voice of customer in regards to the product and ratings of importance, compared with Competitors. The technical in-house capability studied and their co-relation also has been established.

Steps for successful application of QFD involved are:

A process of interaction with the customers is set up

Customers are identified

Their requirements are assessed

Their requirements are translated into engineering characteristics for new products, for the existing products on means of improvements.

Sub Step 16: Calculate the CONC (Cost of Non Conformance), Cost of Prevention and Appraisal Cost:

An critical analysis of these cost elements reveal that the largest portion of quality costs may be attributed to first few of the elements namely – rework, scrap, inspection, complaints and vendor scrap. It is significant that these are either Appraisal or Failure Costs. *In other words, the greatest costs arise from the correction effort rather than the prevention effort.*

Step 12A: Market Orientation & Customer Driven: Internal & External

Sub Step 1: Establish Market Information System:

Identifying the customer need requires a strong/efficient Marketing Information System (MIS).

Major Activities of MIS:

Assessing Information Needs of Marketing Managers

Developing Information about Marketing Environment

Distributing Information to Marketing Managers

The Market information collection and analysis is done through a systematic and periodic approach. The Organisation may hire external agencies or may carry out through its own internal resources.

Sub Step 2: Closed Loop Feed Back System in all Areas:

Closed loop feed back system is followed in all areas/ activity whether it is related to external customers or internal.

Sub Step 3: Survey for Customer Satisfaction:

Units calculate Customer Satisfaction Index (CSI).

*For calculating **CSI of external customer**, attributes may comprise of:*

Perceived Quality

Customer Expectation

Perceived Image

Perceived Value

Customer Satisfaction

Customer Loyalty

*Some common parameters for measuring **CSI for Internal Customers**:*

Communication

Involvement

Response Time

Customer Friendly Attitude

Innovative Approach

Training and Guidance

Problem Solving at Lower Level

Quality of Service

(Refer CD-1, Exhibit-3.19, CSI –Cement Industry).

Sub Step 4: System to Serve Customer after Sales:

There should be a proper system of After Sale Service.

Sub Step 5: System of Registering and Solving Customer Complaints:

About 34% of customers who register major complaints will buy again from the company if their complaint is resolved, and this rises to 52% for minor complaints. If the complaint is resolved quickly, between 52% (major complaints) and 95% (minor complaints) will buy again from the company.

Therefore, companies should develop a strong Customer Complaint Handling System.

- Companies make it easy for the dis-satisfied customer to complain.
- The employees of the Company who receive complaints are well trained and empowered to resolve customer problems speedily and satisfactorily.
- Companies go beyond satisfying particular customers and discovering and correcting the root cause of frequent problems.

Sub Step 6: System of Investigating Product Non-conformities:

Each non-conformity is thoroughly studied with data and application of problem solving techniques. The root cause is identified and eliminated

Sub Step 7: Collection of Data on Competitor's Customer

Various means are used for collecting *Data about the Customers of the Competitors* like:

Employees of Competitors (especially sales force)

Distribution Channel

Suppliers

Market Research Firms

Trade Associations

Magazines

Articles etc.

Sub Step 8: Customer Education System:

Customer education refers to training the customers to use the product properly efficiently and safely. Units should put up a proper Customer Education System

Following are various means of educating customers:

Classroom and On Site Training (especially in case of industrial Goods)

Advertisement

Catalogue

Videos etc.

For more examples on Customer Satisfaction Indices refer write-up on Market Orientation and Customer Driven (both Internal and External) **(Refer CD-1, Exhibit-3.20, CSI -** Staple Fibre Company).

Step 12B: Liaison, Team Force & Skills Development

Sub Step 1: Continuous Updating of Skills through On the Job and Class Room Training:

Skill Development is a Continuous Process and systematically planned for all employees to:

Assist the employees to use more effectively his skills, talents and knowledge

Assist the employee in expanding his skills, talents and knowledge

Assist in finding true potential and preparing him for greater and higher responsibilities

Improve the present work performance through 'improvement of skills'

Prepare for the potential growth development in the future through knowledge gain

Sub Step 2: Prepare Skill Chart for All Employees:

Before starting training for skill development, evaluation should be done of the present status. **(Refer CD-1, Exhibit-3.21,** Multi-skilling Chart)

Sub Step 3: Develop Multi Skilled Employees:

To enhance multi skills, the Unit should develops skill enhancement programs for each employee. For this, as a first step, every employee's skill level is assessed and the gap is identified. Unit creates multi-skilled employees through job rotation and or by other means. **(Refer CD-1, Exhibit-3.22,** Multi-skilled Employees)

Sub Step 4: Develop Understanding within the Organization:

Understanding between employees is developed to pool their talent and train them to play together compensating for individual strengths and weaknesses. Understanding is developed not only between the members of a team but also between different departments, with trade unions.

Sub Step 5: Develop System for Continuous Updating of Skills and Training Program:

Sub Step 6: Integrate and Share Knowledge with Industrial Neighbours:

Knowledge and the expertise are shared with the neighbouring Units, Universities and Educational Institute. Neighbouring Units are invited to visit plant and vice versa. Industrial visits and project training is provided to students from the neighbouring Universities and Educational Institutes. Employees are encouraged to contribute articles, papers etc. to Journals, Seminars and Conferences. . **(Refer CD-1, Exhibit-3.23,** Employees Participation from a Group Carbon Black company).

Sub Step 7: Develop Understanding with all the Supplier and all External Customers:

In World Class Manufacturing, from supplier to the end user (customer) it is a single chain. If any part of this chain is not working properly then the aim of customer delight gets affected. For developing understanding between suppliers and external customers, suppliers and customer meets are organised. Suppliers' units are also visited and close interaction is established with customers.

Step 13: JIT & Stock Reduction/ Supply Chain Management

Sub Step 1: Backward Production Planning System:

Backward Production Planning System is based on pull system only. Whole Production Planning is based on customer demand. First customer demand is identified and then the rest is planned accordingly.

Sub Step 2: Identify Critical Items and Suppliers:

. Some items and suppliers are more critical then the others from inventory management point of view. It may be because of the scarcity of the items, monopoly of the supplier or any other reason. It is very essential to identify these critical items and suppliers for reaping of the

benefit.

Sub Step 3: Vendor Development:

Establishing reliable suppliers is a pre requisite for JIT. This also means rationalizing the number of suppliers. Proper 'Vendor Rating' system is put in place. Various points are considered while selecting Suppliers e.g. Close to plant, Quality of supplies, Good industrial relations, Existing number of suppliers, Long term contracts, very short lead times, Ability to deliver in small lots. Supplier is treated as co-maker.

Sub Step 4: Determine the Economic Order Quantity for all Purchased Items:

Inventory decision-making involves knowing when to order (*Re-order Point*) and how much to order *(Economic Order Quantity*). The Economic Order Quantity (EOQ) is determined by observing how Order-processing costs and Inventory-carrying costs sum up at different order levels. The O*rder Processing Cost per Unit* decreases with the number of units ordered because the order costs are spread over more units. *Inventory-Carrying Charges per Unit* increase with the number of units ordered because each unit remains longer in inventory. By trading off between these two costs, EOQ for all the purchased items is determined.

Sub Step 5: Reduce Production and Delivery Lead Time:

The non-value adding activities significantly add to the cycle time. Identifying and eliminating all the non-value adding activities reduce production and Delivery Lead Time. The DOL approach is important for its control.

Sub Step 6: Application of SMED (Single Minute Exchange of Die)/ QCO (Quick Change Over):

The SMED approach gives a three-stage system for shortening set-up time. These three stages are:

Separate Internal Set-up from External Setup

Convert Internal Set-up to External Set-up

Streamline all Aspects of Set-up

Some examples of a*pplication of SMED/ QCO*:-

At one of group unit (namely Hindalco Industries) the Slitting Machine change over time

At one of group unit (namely Harihar Polifibre) the Chipper Knife changeover reduced to 50%. **(Refer CD-1, Exhibit-3.24, Example of SMED/QCO)**

Sub Step 7: System of Reducing WIP:

Inventory can be in three forms; Raw Material, Work in Process (WIP) and Finished Goods. WIP forms significant part of inventory. One-way of managing WIP inventory is KANBAN.

Sub Step 8: Control on Raw Material and Finished Goods:

The stocks are not allowed to exceed a specific limit. For deciding raw material stock levels, standard analysis is conducted. All the causes of keeping inventory are identified and counter measures are devised.

Sub Step 9: Improve Material Flow by Optimising the Layout:

A *Process-Based Layout* allows material and parts to flow through the process steps in small batches or even one by one, without large amounts of WIP between steps. This approach, called *Flow Manufacturing*, not only saves space, but also eliminates many delays so that parts flow through the process quickly.

Sub Step10: Improve Material Handling System:

Examples: - At one of group company namely; Hindalco Industries, the total reduction in Cycle Time of 195 minutes resulted in the increase of Throughput by 15 Tons per day of billet casted. **(Refer CD-1, Exhibit-3.25, JIT Examples)**

Sub Step 11: Establish Controls for Packaging, Preservation & Marking for all Products:

Proper packaging for safe storage & handling and marking for clear identification of the product as well as date of manufacturing are established. This is essential to ensure FIFO (First in First Out) and shelf life preservation.

Sub Step 12: Ensure Traceability of any Customer Order in the Manufacturing Process:

This is a part of the planning and scheduling system. It is important for the system to enable presenting up to date status of any customer order.

Step 14: Safety, Hygiene and Pollution Control

Sub Step1: Establish and Audit Environmental Management System (ISO 14000):

WCM expects all Units to be ISO 14000 Certified. Certificate is the end result for which lots of activities are carried out and most of them continue even after getting certificate. An Environment Management System (EMS) is established and monitored through periodic audits.

Sub Step 2: System of Regular Health Check for All Employees:

Proper system of regular health check up of all the employees is a prime requirement.

Sub Step 3: Data on Recording System for Accidents

Units keep proper records of all the accidents under the headings: Major Accidents, Minor Accidents, and Near Miss Cases. Root Cause analysis is carried out for all these cases. All this data is visually displayed at specific locations in unit through the Activity Boards, Caution Boards and Meeting Boards etc.

Sub Step 4: Establish Effective Safety Systems:

A production plant is a vast human-machine complex. To eliminate accidents and pollution, specific steps are taken to strengthen the organisation and management of both people and equipment. A Company wide *Management System* is built so that it supports, promotes, and directs the creation of safe, pollution free and a hospitable workplace

Sub Step5: System of Receiving and Implementing Safety Proposals from All Employees:

A system of receiving and implementing Safety Proposals from all the employees is a part of Safety Systems. For collecting the safety proposals, safety competitions are conducted e.g. Safety Poster Competition, Safety Slogan Competition. For encouraging such kind of activities the Winners are duly awarded or rewarded on Annual Safety Day or during Safety Week. The best way to encourage more safety proposals is to implement the suggestions proposed by the employees, which are worth implementing.

Sub Step 6 & 7: Impart Training against Dangerous Occurrences to all Employees:

This Training is an essential activity for maintaining awareness and preparedness for averting/ combating any eventuality against dangerous occurrences in an organization and to maintain a

safe, hygienic and clean environment.

Sub Step 8: Install Public Wash Facilities:

These facilities should be easily accessible for all the employees ensuring effective public wash facilities, at the same time a well maintained and hygienic condition.

Sub Step 9: Train All Employees on Good Hygiene Practices, First Aid and Emergency Handling:

All the employees are trained to be capable of providing first Aid and be able to handle emergency situations. For this purpose training sessions are organised and Safety manuals are distributed in Local language. Employees are trained in Good and Hygienic practices like, washing hands and mouth before taking tea or meals.

Sub Step 10: Preparation and Display of Safety Manuals, Emergency Handling Procedures:

Safety Manuals are prepared (preferably in local language) and distributed amongst the employees and at the same time these are kept at some important and common places like Meeting Areas, Canteen, etc. Similarly, Emergency Plans/Procedures are prepared and displayed at all the prominent locations.

Sub Step 11: Improve and Install Pollution Control Equipment:

Equipments are installed for controlling various types of pollution like Noise, Air and Water which are periodically upgraded.

Sub Step 12: Plant Trees around the Factory Premises:

Planting trees around the factory premises is the best way to control pollution in Natural Way. It is a good practice to use the treated effluent to irrigate the plantation. The master plan of the Unit indicates the green patches. Apart from aesthetically satisfying, greenery also helps control pollution in the plant.

Step 15 A: Information and Systems (BPR)

Sub Step 1: Establish MIS and ERP:

In order to effectively utilise the MIS, the decisions, monitoring and control requirements of every job are identified along with the relevant timely information necessary. A job analysis may be required as a pre-requisite to install an MIS System. To integrate all functional

information and to provide on line decision support an ERP with several functional modules is a big advantage. Where MIS requirements are integrated with ERP the organization can gain considerable leverage. **(Refer CD-1, Exhibit-3.26,** Example presentation on Information and Systems of a Group's units; namely Indo Thai Synthetics, **Exhibit-3.27,** Energy Center Report, Raipur)

Sub Step 2: Integrating Relevant Information with Suppliers, Operations and Customers through IT:

All the relevant information of the business is required to be integrated with the Suppliers, Operations and Customer.

Sub Step 3 & 4: Information on Market Demand and Sub Contractor's Capability and Linkage:

System of gathering information on market demands from existing customer, competitor's customers, new market etc on an on going basis is absolutely essential for business planning. Market share movement can provide some indication on market demand. In order to cope with the market demand it is essential to have all the details of the supplier's capability. Linkage of Information System with Market Demands and Sub Contractors Capabilities is equally important for overall system's effectiveness.

Sub Step 5: Establish Integrated Database for Customers to Access Databank Freely:

This is an advanced integration where through on line means the Customers are provided with limited access to the data bank. This facility provides instantaneous information to customers regarding their order status and the expected delivery date. This is sure to enhance the customer delight.

Sub Step 6: Analyse the Present Systems and Improve Responsiveness through BPR Approach:

Identify all systems and Sub systems e.g. ordering system, purchase, raw material ordering system, customer order capturing system, invoice tracking system, customer complaint handling system, order execution system etc.

Map the process in detail including time at each workstation

Analyse and identify scope for speeding up through simplification, parallel processing and elimination of NVA work stations/ activities.

Depending on the criticality of the system prioritise e.g. process/ systems that have direct impact on the external customer should get the immediate priority.

Example of NVA analysis:-

At one of group units namely Bhiwani Textile the analysis revealed 86.81% NVA and only 13.19% VA **(Refer CD-1, Exhibit-3.28, BPR-Process Mapping)**

Step 15 B: Technology

Sub Step 1: Identify and Evaluate Alternate Emerging Technologies and Upgrade the Process:

The organization is expected to continuously keep an eye on the alternative emerging technologies, keep itself updated with the technological changes occurring in the world. A system for evaluating the new technologies and plans for enhancement should be in place. Smooth absorption of new technologies through appropriate proportions/ training is facilitated. The new technology up gradation covers Product, Process, Information Systems, Work Environment, Equipment logistics etc.

Sub Step 2: Develop Electronic Control Mechanism for controlling all the Processes:

For perfect Process Control, electronic systems such as DCS, or local automation such as PID Controller, are essential. Particularly when Multi variables are involved, automated process control considerably helps. The critical processes are identified and systematically covered through automated process control systems.

Step 15 C: Cash Flows

Sub Step 1: Use Cash Flow Techniques for All Decision Analysis:

Whenever any decision is taken, it impacts the cost or revenue either directly or indirectly. An assessment of its impact is required prior to committing the decision. Cash flow projection forms such an assessment. A system of evaluating the impact of on cost and revenue prior to decision is an essential step.

Sub Step 2: System for Controlling Future Economic Inflows:

The future cash flow is guaranteed for survival. All parameters that influence future cash flow are taken under control. A system of identifying and monitoring these parameters along with the proactive stand is essential. Parameters such as Market growth, volumes, Margins, Key

cost drivers, key revenue drivers are closely tracked.

Sub Step 3: Control over Initial Investments, Operational Cash Flows and Terminal Cash Flows:

All investments are properly assessed taking into account initial cash flows, operational cash flows and terminal cash flows. A detailed analysis with all projections is carried out prior to plunging into an investment decision. Any investment made without proper appraisal is bound to retard the progress of whole organisation and leave it with financial burden.

Sub Step 4: Develop System for Measuring and Monitoring Opportunity Cost for All Investments:

There is a periodic assessment of value added for each investment. A comparison is made with the value addition that would have occurred with other available opportunities.

Step 15 D: World Class Office Management (WCOM)

Sub Step 1: Training on WCOM:

A specialised training on World Class Office Management is conducted for all the Administrative Departments and other support departments for enhancing administrative and support functions. The training is facilitated through the Corporate WCM cell.

Sub Step 2: Implementation of 5S in the Office Areas:

For creating an ideal Work environment the organisation practices the principles of 5S.

Example: At one of the group unit namely JayaShri Textile, self-cleaning and upkeep of Telephones and Computers done by user staff members is bringing a saving of U.K.£ 52 per month

Sub Step 3: Identification and Elimination of Office Waste:

All types of wastes are identified and eliminated.

Example: At Jaya Shri Textile, the reduction in unnecessary communication expenses brought saving of U.K.£ 32000. Similarly, by clubbing of Licences a saving of U.K.£ 365 could be achieved.

Sub Step 4: Practice Kaizen and Autonomous Maintenance in the Office:

Office Machine and Equipment are an integral part of any office. They are the tools, which help office work to be carried out effectively and efficiently. They also help in accurate and speedy functioning and handling of operations. Therefore, they are maintained in the best possible manner through Autonomous Maintenance and Kaizen.

Example: At JayaShri Textile, by carrying out Kaizen in the music channel system with telephone, and public announcement system, many inconveniences and delays were avoided.

Sub Step 5: Practice Visual Management:

For transparency in the process the unit practices Visual Management through various means like Abnormality Management, Movement Record, Customer Complaint handling, QCDIP, Process Performance of Teams etc.

Sub Step 6: Streamlining Office Systems and Procedures:

For the simplification in the existing system following guidelines are to be followed:

- Identify all systems and Sub systems e.g. incoming and outgoing mail, purchase, raw material ordering system, customer order capturing system, invoice tracking system, customer complaint handling system, order execution system etc.
- Map the process in detail
- Analyse and identify scope for speeding up through simplification, parallel processing and elimination of NVA work stations/ activities.
- Depending on the criticality of the system prioritise e.g. process/ systems that have direct impact on the external customer should get the immediate priority.

Sub Step 7: Reduction in Office Inventory:

To reduce the Office inventory level following steps are to be performed:

- Identification of all the Office items
- Identification of critical items
- Analysis of present inventory level
- Identification of Suppliers and their delivery lead time
- Arriving at the optimal inventory level
- Reviewing the contract
- Measuring and monitoring

Example: At one of the group units namely Bihar Caustic, by segregation of documents and

records as well as using used papers for internal correspondences a substantial saving of approx U.K.£1300 was achieved.

Sub Step 8: Achieved the Status of "Paperless Office"

The information age has minimised the use of paper now. Use of E-mail for correspondence and diskettes for keeping the records has resulted in Paperless data processing. The Organisation therefore makes use of the above techniques for gradually leading to "Paperless Office".

Sub Step 9: Developing an Office Culture, which Stresses on Internal and External Customer:

The concept of Internal as well as the external customer is percolated in the Office. The awareness regarding the need of the customer and defining the QCDIP is developed in each employee irrespective of his position.

Sub Step 10: Encourage Office Safety, Hygiene and Pollution Control:

Following are the guidelines for the above:

- Train all the employees on safety, good Hygienic practices, first aid, emergency handling
- Prepare safety displays, safety manuals and emergency handling procedures
- Improve and install Pollution control equipment
- Install public wash facility
- Monitor the performance of equipment like water cooler, air conditioners, air purifiers, exhaust system
- Conduct periodic pest control
- Set up system for regular health check of the employees
- Analyse potential accident and prepare for prevention

Step 16: Measuring and Monitoring Results

Sub Step 1: External and Internal Customer Satisfaction:

The various means used are:

1. OTIF (On Time in Full) Delivery to the Customer: Customers favour those firms that can deliver their goods, '*On Time in Full*'. So Units have a proper track of their delivery system.
2. Six Monthly Surveys for Internal Customer Satisfaction Level
3. Periodic Surveys for External Customer Satisfaction Level

4. Identify and Monitor Co-relation between Customer Satisfaction and Financial Performance: Periodic identification and Monitoring of Co-relation between Customer Satisfaction and Financial Performance is very essential. It should be positive.
5. Identify and Monitor Co-relation between Product Quality
6. Customer Satisfaction
7. Establish and Monitor Customer Delight Index

Sub Step 2: Social Satisfaction:

Just like Internal and External Customer Satisfaction, Social Satisfaction is measured and monitored periodically. Various attributes are considered while measuring social satisfaction; some of them are listed below:

a) Perception of the Society about the Organization on the following: Education & Training, Medical and Welfare, Sports & Leisure, Rural Development, Employment Opportunities,
   Most Preferred Employer
b) Contribution Towards preservation of Global Resources
c) Cordial relationship with society
d) Violation of national and international standards and regulations by company
e) Integration of Society's interest into Business action
f) Accolades and Awards received by the Unit with respect to societal responsibility.

Sub Step 3: Display and Monitor Financial Results:

The Financial Results, which show the actual Business Process Performance are measured and monitored periodically. All these results are also displayed. Some of these main parameters are:

1. Annual Turnover
2. Profit After Tax (PAT)
3. Inventory Turnover
4. Return on Investment
5. Shareholders Return/ Return on Assets
6. Net Asset Value
7. Sales per Unit of Capital Employed
8. Trends of Market Share
9. Saving in Materials

10. Trends of Revenue Growth

Sub Step 4: Performance and Productivity Indicators:

Some of the main attributes are:

1. OEE of the Critical Equipment
2. MTTR of all Critical Equipment
3. MTBF of all Critical Equipment
4. Percentage Elimination of Waste in all the Areas
5. OTIF Delivery from all Suppliers
6. Percentage Reduction in WIP
7. Percentage Reduction in Cost of Non-Conformance
8. Labour Productivity
9. Cumulative Savings through Implementation of Kaizen Suggestions

Sub Step 5: Optimal Cycle Time:

The below mentioned things are measured and monitored on periodic basis to make them optimum. There is a system of continuous measuring the lead times and comparing with the target.

1. Procurement Lead Time
2. Product Delivery Time
3. Complaint Handling Time
4. New Product/ Service Introduction Time
5. Time to break even on New Project/ Changes

Examples of manufacturing Cycle Time reduction;

The total manufacturing cycle time in group unit namely at Grasim SFD Nagda has reduced from 968 minutes to 908 minutes within a period of 24 months.

In another group unit namely Birla Copper it has reduced from 9 hrs 17 minutes to 7 hrs 26 minutes within a period of 24 months.

And in another group unit namely Birla Cellulosic it has reduced from 84 minutes to 70 minutes within a period of 24 months.

Sub Step 6: Percentage Reduction in Pollution Levels:

It is essential to control the pollution levels not only from Safety and Hygiene point of view but also from the legal point of view. Moreover Zero Pollution also means zero losses as

pollution is caused due to plant wastes. Air, Water and Land pollution is measured and monitored periodically and data is stored for perusal and monitoring.

Sub Step 7: Rewards for the Highly Competing Teams:

Competitions and Rewards are very helpful in boosting the motivation level of the Employees/ Teams. These give recognition to Teams/ Employees. Further competition brings lot of innovative ideas, which are helpful for the organization. Following Competitions are organized on monthly basis (Results are displayed visually) and the winners are rewarded appropriately:

1) Best Kaizen Theme
2) Best 5S Area
3) Best Model Equipment/ Area
4) Best Safety Poster

Step 17 A: Documentation for Pre-Assessment for

Sub Step 1: Chairman's Bronze Medal for Visual Management

Sub Step 2: Chairman's Silver Medal for Manufacturing Culture Revolution

Sub Step 3: Chairman's Gold Medal for Manufacturing Excellence

Sub Step 4: Pre Assessment by WCM Team for Awards

Sub Step 5: Implement the Recommendation of the Assessors

Step 17 B: Final Assessment for

Sub Step 1: Chairman's Bronze Medal for Visual Management

Sub Step 2: Chairman's Silver Medal for Manufacturing Culture Revolution

Sub Step 3: Chairman's Gold Medal for Manufacturing Excellence

3.5.3 Launching the Revolution

In the fast track competition, evolution is not enough. Growth is essential, but the pace also matters. A real time revolution involving all is required and that has to be initiated by the CEO. For launching the revolution for manufacturing excellence in a Group / Unit, various activities are conducted. These activities include:

3.5.3 (a) Two Days Conference cum Workshop

For building the Will, Two Days Conference cum Workshop is conducted by Corporate Cell in individual Unit. Here, the basic foundation of WCM Program is laid down. Theoretical as well as the practical aspects is made clear in this Conference cum Workshop.

For the inspirational part, the WCM Conference cum Workshop has exceptional potential and acts as **stimulus to the Cultural Change.** ***The Conference cum Workshop*** is a sophisticated model, wherein organisation abandons the traditional demarcation between managers and the managed and instead recognises that all employees will need to assume some managerial responsibility.

The next step is **fulfilment of motivational requirements** by setting aside assumptions taken for granted about human motivation. Conventional management is based upon the view of motivation emanating from the early days of industrialisation, when agricultural labour proved reluctant to submit to factory rules. WCM studies motivation because it assumes that motivation is problematic.

The Conference cum Workshop is fulfilling this task effectively. If asked for a single reason for the existence of abnormality, **employees voluntarily express** their commitment for driving out all abnormalities from their work area and come forward with improvement projects. There are many proposals to improve the work practices from the operators end itself; some teams have improved their work areas to a considerably higher standard in Ware House and Process House, and all this is happening without any formal project assigned to them.

"If you are going to sweep the stairs always start at the top." (Refer book: Harrington H. James with Harrington James S. (1995), *Total Improvement Management – The Next Generation in Performance Improvement*, McGraw-Hill Inc., New York.)

"Flowers grow from below but must be watered from above" (Refer book: Robson Mike, *The Journey to Excellence.*)

Organisations aiming to be World Class undergo a Change, with the driving force for change coming from Top Management.

"The Starting point of all achievement is desire. Keep this constantly in mind. Weak desires bring weak results, just as a small amount of fire makes a small amount of heat." (Refer book: Creech Bill (1994), *The Five Pillars of TQM – How to Make Total Quality Management Work For You*, TRUMAN TALLEY BOOKS? PLUME Penguin Group, New York.)

To implement WCM, the Will to change must there, especially at the Top Management level.

"Product is the focal point for organisation purpose and achievement. Quality in the product is impossible without quality in the process. Quality in the process is impossible without the right organisation. The right organisation is meaningless without the proper leadership."

Though a Product is an output of a process but to have a World Class Product, Quality has to be built into the Process and the systems and the change process has to be supported by a strong, visionary and a dynamic leadership. It is not enough just to have good managers but it is also necessary to have good leaders.

"Leaders provide the vision; managers carry it out. Leaders make it better; managers make it run. Leaders make it happens; managers hope it happens. Leaders create more leaders; managers create more managers."

"Managers manage within a paradigm. Leaders lead between paradigms." (Refer book: Hakes Chris (1999), *The Business Excellence Handbook*, Bristol Quality Centre Ltd., Bristol)

Main purposes of Conference and Workshop are:

- Build up the Top Management Will, thus getting a Commitment from them.
- To introduce and proliferate the concepts, tools and techniques of World Class Manufacturing at all levels.
- Develop *Champions of Change* to further proliferate the WCM Concepts in plant once the Conference and Workshop is over.
- Establish a common language amongst the Champions of Change.
- Develop a Culture for Excellence involving People, and Creating a Mindset for doing Quality work in all that we do, every time, all the time.

The teams are provided with **detailed guidelines** and formats to help in Carrying out the exercise, which will be followed by presentation.

The basic purpose of these exercises is to **develop an eye for Abnormality** and to be able to use all the five senses in identifying and eliminating Abnormalities. The participants are divided into cross-functional Teams that are assigned pre-determined areas.

One guide belonging to that area accompanies the Team in order to **clear their doubts** about the equipment conditions etc. Participants are required to identify various abnormalities according to the Eight Types of Abnormalities. These observations are filled in the Zero Abnormality Movement Format.

The participants after observing the Abnormalities, Waste and the Potential failures in the area

assigned to them, prepare a **presentation** on their observations. On the *second day* the presentation is made in the presence of the CEO. An Action Plan is prepared for rectification of the Abnormalities and Waste identified during the Conference cum Workshop.

3.5.3 (b) Train the Trainers Program

This program is held at different venues. The purpose is to develop **WCM Trainers** for proliferating the WCM Concept across the Group.

3.5.3 (c) In house Conference cum Workshop

Units/ Individual Units are then made responsible to conduct the In house Conference cum Workshop for the remaining employees. The Champions developed during Train the Trainers program and Two Days Conference cum Workshop hold this type of Conference cum Workshop.

To cover rest of the employees a series of in-house Conference cum Workshops are conducted by the WCM Secretariat with the help of Champions developed during the Conference cum Workshop conducted by Corporate WCM Cell. This program is a replica of the Conference cum Workshop conducted by Corporate WCM Cell. Here the focus is the eight dimensions and the Zero Abnormality Movement. The purpose is to proliferate the WCM Culture throughout the Organisation. Action plan for Abnormalities identified by the participants during these Programs is prepared. Records of these Conferences cum Workshop are to be kept ready with the WCM Secretariat.

The Unit makes time bound action plan to cover all employees through the conference. In-house trainers are identified and the training material is translated to local language.

Launching the Revolution is just the beginning, but well begun is half done. For systematic implementation, there is a 17 Steps Master Action Plan. As discussed various activities under this Master Action Plan are implemented through WCM Facilitating Structure.

3.5.4 Sustaining the Momentum

For sustaining the momentum of the WCM Program progress various activities are carried out at the **Unit Level** and **Corporate Level.**

3.5.4 (a) Activities at Unit Level

Specialised Workshop on Advanced Topics:

A Specialized Workshop on more than 26 Topics is conducted to accelerate the WCM activities. Some of them are 5S, JIT, Muda, COQ, SPC, Autonomous Maintenance, and Planned Maintenance.

Follow up Visit:

Once the WCM program is launched in a Unit, it is continuously monitored through Facilitator's follow up visits. Facilitators (Key people involved in implementation of WCM Program, besides people from WCM facilitating structure) not only review the progress but also share the success stories of other Units.

Establishing Common WCM Language:

Common WCM language means total alignment of all employees in the concepts and practice of WCM initiatives. The several key words mean the same to every employee irrespective of the location. The understanding is uniform. For example, usage of the following terms in day-to-day dealings:

- Abnormality
- Muda
- QCDIP
- Respect for standards
- Customer: Internal and External
- 5S
- Cleaning is inspection etc.

The WCM awareness is reflected only when all the employees irrespective of their position use these terms.

3.5.4 (b) Activities at Corporate Level

Annual Review Meeting

A few days session is organised at the corporate level to discuss the various issues and to review the WCM Program progress at Units. Unit WCM secretariat heads and members of the Unit's WCM secretariat attend the meeting. Members exchange notes and share their success stories amongst one another. This exercise also results in a keen competition amongst the

participants who feel motivated by the results achieved by the other Units. The same forum may be used for providing deep knowledge about certain aspects of WCM. Only the success stories should not be discussed, problems and impediments should also be discussed in detail and efforts should be made for reaching a solution.

Monthly Status Report & Score Card

Plants reports their monthly progress of WCM activities over specified points through the *Status Report*, and based on this report *Score Card* of Plants is prepared. This Score Card is shared with the Plants. The purpose is to monitor the progress and to create healthy competition amongst the Units.

News Letter

At Corporate level, News Letters are taken out at regular intervals. The Newsletter serves the purpose of cultivating healthy competition amongst the Group Units. It also depicts a clear picture of not only what the Units are doing but also what they have already achieved and their future plan.

Special News Letters

The Special Newsletter like the General Newsletter depict *The Journey towards Manufacturing Excellence* of one particular Unit/Industry e.g. Special Newsletter on Textile industry or Cement industry. It also serves the purpose of cultivating healthy competition amongst the Group Units.

Awards for Excellence

The ***Awards for Manufacturing Excellence*** has been instituted at the corporate level to track and measure the business performance of Manufacturing Units. It enhances the competitiveness of the Units on their journey towards Manufacturing Excellence.

The purpose of these Awards is to:

- Stimulates and assist Group Units to participate in Improvement activities leading to World Class Manufacturing.
- Inspire and motivate a healthy competitive environment within the Group Units and prepare them for competitive challenges from global players.
- Facilitate knowledge integration to improve the overall Group excellence.

Categories of Awards are:

1. **Gold Medal** for Manufacturing Excellence
2. **Silver Medal** for Manufacturing Culture Revolution.
3. **Bronze Medal** for Visual Management

There is also a **Commendation Certificate** for significant achievement in WCM implementation.

The Awards act as a diagnostic tool for tracking the success. This diagnosis helps in focusing on critical areas:

CHAPTER 4

RESULTS OF WCM APPLICATION

4.1 INTRODUCTION

The intent of this chapter is to highlight the benefits accrued due to the application of World Class Manufacturing (WCM) Tools and Techniques. The various Qualitative and Quantitative parameters the author wishes to highlight are the Key WCM Indicators.

4.2 WCM KEY INDICATOR RESULTS

The flexibility of WCM is that the indicators identified for the assessment of the WCM Process in an Organization can also be used for the Results obtained due to the deep deployment of the WCM Model for Competitive Advantage in the Organization. These result indicators identified in terms of QCDIP, give a comprehensive statement of the extent of WCM deployment in the organisation.

QUALITY

Quality in WCM is treated as a strategic issue. Hence the parameters under this heading cover not only the basic parameters but also capture the needs of the customer. The various quality parameters are:

- Process Defect Rate
- Reprocessing Rate
- Scrap Rate
- Cp and Cpk
- Number of Customer Complaints
- Internal Customer Satisfaction Index
- External Customer Satisfaction Index

(Any product whether in-process or on-completion of processing which does not meet the required specifications is said to be defective and the ratio of a number of such products to the total quantity produced may be termed as Process Defect Rate. It includes both reprocessing and scrap rates. Those products, which cannot be reprocessed, and have to be totally rejected are known as scrap and the ratio of such products to the total quantity produced is termed as Scrap Rate.)

COST

It is a normal belief that a good quality product is associated with a high cost. But the author's WCM has a different philosophy. WCM propagates that the best quality product has to be made available/produced at the lowest cost. This is very logical and has been analysed in detail. To make it clearer, if one considers the removal of in process variations as a primary Quality objective then it is quite possible to manufacture the "Best Quality" product at the lowest possible cost. This is reflected in the following parameters;

- Savings by Process Technology Up gradation
- Savings due to reduction in Maintenance Cost
- Savings in Energy and Utilities
- Savings due to Maintenance Prevention Design
- Inventory Turnover (Raw Material, Work in Process, Final Goods Inventory)
- Savings due to Waste Elimination
- Cost of Quality
- Savings through Kaizens
- Waste Elimination Cases Identified / Eliminated

DELIVERY

The WCM philosophy believes that if a best in quality product manufactured/delivered at the lowest possible cost is well supported by a sound delivery system, it can increase the equity for that particular brand name. The measuring and monitoring delivery parameters are:

- Reduction in the number of Late Deliveries
- On Time in Full Delivery to Customers
- On Time in Full Delivery from the Vendors/Suppliers

INNOVATION

All the above-mentioned parameters comprise of a family of parameters known as the hard parameters where the metrics are easy to define. WCM as propounded by the Author takes into consideration both the hard as well as soft parameters. One of the important soft parameters in WCM is Innovation. The author believes that innovation is and will be one of the main factors for the success of business enterprises. These parameters are listed below:

- Number of Innovations per Employee (Technological or other)
- Number of Systems Simplified
- Number of Kaizens per employee

PRODUCTIVITY

The intelligent application of Innovation in any Industry can lead to the On Time in Full Delivery of a low cost, best quality product which can further lead to an increase in productivity levels. The metrics for measuring and monitoring productivity levels are listed below:

- Manpower Productivity
- Throughput Yield
- Reduction in Planned Shutdown
- Set up/Changeover time
- Increase in Mean Time Between Failures (MTBF)
- Reduction in Mean Time To Repair (MTTR)
- Increase in Overall Equipment Effectiveness (OEE)
- Reduction in Manufacturing Cycle Time
- Improvement in 5S Index

Most of the Tangible and intangible Results, which are shown in the subsequent pages, have been measured directly or indirectly in terms of the above-mentioned parameters.

4.3 TANGIBLE RESULTS

{Conversion rates: A. 1 UK Pound Sterling (£) = 12898.39 Indonesian Rupiah}
as on 29th May, 2002 = 71.44 Indian Rupees also referred as Rs.)}
= 61.99 Thailand Bahts}

4.3.1 SUMMARY OF ACHIEVEMENTS OF GROUP UNITS

S N	Units →	Company 1- Grasim, SFD, Nagda					Company 2-Thai Polyphosphate & Chem.				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till Qtr.*
1	Quality					Target /Actual					Target /Actual
	Process Defect	*G.R*	%	6.90	6.30	2.00 / 3.10					
	Reprocessing	*Rate*	%	0.37	0.44	0.25 / 1.22	*Rate*	MT	423.95	422.06	
	Scrap	*Rate*	%	0.57	0.47	0.43 / -	*Rate*	MT	10.67	3.30	
	Cp Improvement	*Main Plant*	Index	0.45	0.74	0.64 / 1.30	*SAPP* *TSPCl*	Index Index	1.35 1.11	1.66 1.01	- / 1.39 - / 0.90
	Cpk Improvement	*Main Plant*	Index	0.24	0.57	0.49 / 0.90	*SAPP* *TSPCl*	Index Index	0.92 0.79	1.50 0.78	- / 1.13 - / 0.79
	Cust- Complaint	*Market Report*	Nos.	22	29	0 / 20	*Market Report*	Nos.	15	2	2 / 5
	ICSI	*Surveys*	0 - 10	8.0	8.7	10 / 9.3	*Surveys*	0 – 10			
	ECSI	*Surveys*	0 - 10	5.4	7.7	10. / 7.8	*Surveys*	0 - 10			
2	Cost										
	Techno. Up-grading	Saving	Rs Lacs)	86.92	29.81	- / 154.		Baht (Lacs)			
	Maintenance Cost	Production Base	%	3.63	2.39	2.50 / 3.17	Contractor/ Store/Spares	Baht/Ton	243	300	248 / 185
	Energy Saving	Power/Fibre Steam/Fibre Water/Fibre	Kwh/T Ton/Ton Ton/Ton	1254 7.94 80 00	1167 7.51 60.00	- / 1120 - / 7.68 - / 41.00	Power Used Fuel Used.	Baht Lacs Baht Lacs	45 55	50 68	60 / 55 80 / 82
	MP Design	Saving	Rs (Lacs	50	521	- / 86	Saving	Baht Lacs	1.58	2.63	
	Inventory Turnover (RM, WIP, FG)	R M Sale/WIP Stock Sale/FG Stock	% % %	12.4 0.80 9.60	9.2 0.70 26.20	- / 13.6 - / 0.9 - / 41.30	Phosphoric Acid Soda Ash Caustic Soda STPP/Special	No. Days Days No. Days No. Days	25 28 32 9/25	26 30 31 9/24	15.6 / - 22.4 / - 20.5 / - 7.8/13.7 / -
	Waste Elimination	Cases Savings	No. Rs.	143	204	100% / 87	Cases Savings	No. . Bhat	33	52	- / 3
	Cost of Quality	Sale Base	%	4.27	6.6		Sale Base	%			
	Kaizens Saving	Power/Water/ Steam	Rs. lacs	1818	218			Baht Lacs	122.6	41.4	- / 13.1
3	Delivery										
	Late Delivery Reduction	Immediately after payment									
	OTIF delivery to Customers	Total Dispatch	%	96	94	- / 82	Act./Target Dispatch	%	100	100	100 / 100
	OTIF delivery from Vendors	Lead Time	Days	120	120	- / 90	For Critical Items	%	100	100	100 / 100
4	Innovation										
	Kaizen per Employee	Kaizen per Employee	Ratio	0.4	1	1 / 2	Kaizen/Employee	Nos.	3	4	5 / -

							Per year					
	Systems Simplified		Nos.	8	1	-/11	Improve. Themes	Nos.	20	22	-/3
	Technological Innovation		Nos.	15	13	-/-	Project. Themes	Nos.	11	6	-/-
5	**Productivity**										
	Manpower Productivity	Production Base	Ton/ Worker	111.6	138.12	-/123.91	Production Base	Ton/Worker	338	338	346/349
	Throughput Yield	Product Base	Kg/Ton Fibre	1031	1019	-/1009	Capacity Utilization 215T STPP/Day	%	100.	101	100/-
	Planned Shutdown	Reduction	Hrs	859.76	476.58	-/1009	Reduction	Hrs	69.5	107.08	
	MTBF	Increase	Days	1865	1514	-/1592	Increase	Days	19.28	20.71	24/30
	MTTR	Reduction	Hrs	2.37	2.49	-/2.47	Reduction	Hrs	1.46	1.39	1.2/1.58
	OEE	Increase	%	72	80	-/85	Main Plant OPE	%	96.42	98.11	95.98/-
	Manufacturing Cycle Time	Reduction	Minutes	968	968	-/908	Quality Change-over Time	Hrs/yr	96.42	98.11	95.98/-

S N	Units →	Company 3 - Thai Sulphites & Chemicals Co., Ltd.					Company 4 - Harihar Polyfibers				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999 - 2000*	*2000-2001*	*2001-Till Qtr.*
1	**Quality**					Tgt /Actual					Tgt /Actual
	Process Defect	Ordinary Grade	%	1.93	1.39	1.00 / 0.98	Final Quality	%	NIL	NIL	0 / NIL
	Reprocessing →	NA					Total Quantity	%	0.077	0.072	NIL/NIL
	Scrap	NA					Total Production	%	NIL	NIL	0 / NIL
	Cp Improvement							Index Index		0.45	1.0 / 3.32
	Cpk Improvement						Brightness LP Brightness FDP	Index Index	- 0.79	0.78	1.0 / 2.68
	Cust- Complaint	Market Report	Nos.	20	10	5 / 1	Market Report	Nos.	4	4	2 / NIL
	ICSI	Surveys	0 - 10	6.9	7.6	8.5 / 8.1	Surveys	0 – 10	4.8	4.9	5 / 4.5
	ECSI	Surveys	0 - 10	8.5	8.8	9.0 / -	Surveys	0 - 10	4.12	4.9	5 / 4.9
2	**Cost**										
	Process Techno. Up-grading	Saving through FI	Baht (Lacs)	90.84	139.27	75 / 15		Rs (Lacs)	104. 9	80.69	39 / 11.44
	Maintenance Cost	Including Kaizen	Baht/Ton	373.84	376.2	280 / 202.06	Contractor/ Store/Spares	Rs (Lacs)	302. 55	269.71	260/265.4
	Energy Saving	Power SS Power SMBS Steam SS Steam SMBS	Kwh/Ton Kwh/Ton Ton/Ton Ton/Ton	115 177 1.14 0.032	104.5 175 1.13 0.025	100 / 94.1 170 / 174 1.05 / 1.006 0.02 / 0.039	Effective Utilization	Rs/Ton of Pulp	29.5	15.3	39 / 8.45
	MP Design						Saving Projects	Rs (Lacs)	6.52	5.47	2 / 6.91
	Inventory Turnover (RM, WIP,FG)	Total turnover of Inventory		3.98	4.32	6 / 4.67	Annual Sale to Inventory	Ratio	9.71	10.72	11 / 11.99
	Waste Elimination	Cases Savings	No. Bhat	9	11	15 / 5	Cases Savings	No. Rs(Lacs.)	40 23.51	82 56.72	-/42 -/35.01
	Cost of Quality	Total Cost Sale Base	Baht Lacs %	370.6 103	367.2 9.0	350 / - 8.5 / -	Sale Base	%	6.028	5.7	5.4/5.7
	Kaizens Saving	QC Themes	Baht Lacs	13.5	11.5	12 / 2		Rs(Lacs)	1.0	1.5	-/18.02
3	**Delivery**										
	Late Delivery Reduction						Pulp Despatch Base	%	NIL	NIL	0 / NIL
	OTIF delivery to Customers	Due Delivery Date	%	88	96	100 / 100	Pulp Order Quantity Base	%	100	100	100 / 100
	OTIF delivery from	Due Delivery Date	%	94	99	100 /	All Vendors	%	96.5	96.5	98/97

	Vendors					100					
4	**Innovation**										
	Kaizen per Employee	Kaizen/Employee Per year	Nos.	7.43	9.9	6 / 7.68	Kaizen/Employee	Ratio.	0.16	0.28	0.3 / 0.17
	Systems Simplified	Improve. Themes	Nos.	10	14	15 / 4	Improve. Themes	Nos.	12	14	16 / 8
	Technological Innovation	Project. Themes	Nos.	4	3	5 / 2	Project. Themes	Nos.	2	1	- / NIL
5	**Productivity**										
	Manpower Productivity	Production Base	%	119.31	123.47	135 / 139 3	Production Base	Kg / Man hour	15.24	16.19	16.30 /18.32
	Throughput Yield						Wood to Pulp	Ratio.	3.05	3.05	3.05/ 3.05
	Planned Shutdown	Flushing Period Centrifuge W ash SMBS Dryer Clean	Hrs Min./day Nos./run	859.76 30 2	476.58 15 1	- / 1009 0 / 0 0 / 0	Reduction	Days	12	11.5	11.5/ 0.5
	MTBF Increase	DR-317	Hrs	673	435 08	1778 / 1440	Critical Equip.	Days	108	85	120 / 96
	MTTR Reduction	DR-317	Minutes	203	88.92	80 / 5 53	Critical Equip.	Hrs	50	50	50 / 48
	OEE Increase	Overall Plant	%	86.31	88.67	94 / 88 05	Critical Equip.	%	91.8	95.4	96 / 94.6
	Manufacturing Cycle Time						Pulp Quality Maintenance	Hrs	-	-	- / -

SN	Units →	Company 5 - Birla Copper					Company 6 - Birla Cellulosic				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999 - 2000*	*2000-2001*	*2001-Till Qtr.*
1	**Quality**					Tgt /Actual					Tgt /Actual
	Process Defect	To review						%	0.658	0.446	0 / 0.228
	Reprocessing	CC Rod	%	4 06	3.49	- / 3.27	To Compute				
	Scrap	To review					To review		NA	NA	NA / NA
	Cp Improvement	To Compute									
	Cpk Improvement	Sulphur in Cathode O2 in CC Rod	Index Index	5.74 0.899	6.3 1.476	- / 6.3 - / 1.868		Index	0.9 - 5	1.10	1.33/ 1.13
	Cust- Complaint	CC Rod	Nos.	15	30	- / 47	1000 MT Bse	Nos.	1.56.	1.31	0 / 3.54
	ICSI	To Compute		-	-	- / -	Surveys	0-10	7.5	7.7	10 / 9.7
	ECSI	CSMM New Delhi Surveys	0 - 10	-	3.24	0 / -	Surveys	0 - 10	8.1	8.62	10 / -
2	**Cost**										
	Process Techno. Up-grading	In-House FI	Rs.(Lacs)	-	115.73	- / 115.73		Rs (Lacs)	52	75	107/33.78
	Maintenance Cost	R & M Cost	Rs. (Crs.)	25.19	22.32	- / 34.56	Monthly Budget	Rs (Lacs)	56.58	50.58	40 /82.74
	Energy Saving	Base Cathode Production Power Water	Rs.(Lacs.) Rs.(Crs.)	Base Year 1.12	503.43 1.58	- / 1616.78 - / 2.52	Steam Saving Power Saving	T/T fibre Kwh/Ton fibre	8.12 936	7.942 789.65	7.35 /7.32 750 / 812
	MP Design							Rs (Lacs)	4.7	6.12	10 / 7.6
	Inventory Turnover. (RM, WIP, FG)	RM WIP	Rs.(Crs.) Rs.(Crs.)	- -	- -	- / 12.23 - / 19.98	RM (Pulp) Ratio FG Invent. Turn.	(Tp/Tf) Tf/ m/c	1.066 47 9.5	1.041 486.5	1 / 0.52 100/849.7
	Waste Elimination	To Compute Separately		-	-	- / -	Cases Savings	No. Rs(Lacs)	8250	130 171.9	150 / - 200/72.5
	Cost of Quality	To Compute									
	Kaizens Saving	To Compute Separately		-	-	- / -		Rs(Lacs)	344	200	300 / 34
3	**Delivery**										

	Late Delivery	To Compute									
	OTIF delivery to Customers	For Copper Products	%			-/99.24	Despatch Base	%	99	99	100/99
	OTIF delivery from Vendors	To Compute					Coal, Sulphur, Caustic	%	88	90	100/99.39
4	Innovation										
	Kaizen per Employee	To Compute Separately		-	-	-/-	Kaizen/Employee	Ratio.	0.5	1.1	1.5/0.24
	Systems Simplified	To Compute Separately		-	-	-/-	Improve. Themes	Nos.	9	14	25/27
	Technological Innovation	To Compute Separately		-	-	-/-	Project. Themes	Nos.	10	18	25/2
5	Productivity										
	Manpower Productivity	Cathode Production	Kg./Hr	70.27	68.72	-/85.16	Fibre Production Base	Kg Fibre / Man	176	237	250/217.3
	Throughput Yield	Cu Recovery in Smelter	%	97.74	98.27	-/98.28	Capacity Utilize Spg Machine	%	92	102	111/92.3
	Planned Shutdown....	Allowable Process Stoppage Hrs/ day (22.89/24)	%	36.65	26.87	-/15.68	Spg Machine Quality Set-up Change Time	% Hrs Min.	1.62 100	1.34 20	0.90/0.98 0/2.3
	MTBF Increase	Drag-Conveyor	Hrs	392.63	1451.3	-/ Running		Hrs	720	936	1000/860
	MTTR Reduction	Drag-Conveyor	Hrs	8.82	4.69	-/0		Hrs	0.23	0.17	0.10/0.25
	OEE Increase	Refinery Plant	%	82.06	80.23	-/82.9		%	85.0	98.6	99/87.43
	Manufacturing Cycle Time	Converting Cycle in Smelter	Hrs.:Min	9:17	9:25	-/7:26		Min	84	72	70/72

SN	Units →	Company 7 - Indal, Hirakud, Smelter					Company 8 - Indal, Taloja				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till Qtr.*
1	Quality					Tgt /Actual					Tgt /Actual
	Process Defect	Caster Metal Casting Metal Carbon	% % %	8.18 1.05 6.34	5.48 0.7 4.98	6.5/4.67 0.5/0.39 3.5/2.42	NCRs received	Nos.			110/201
	Reprocessing	Caster Metal Casting Metal Carbon	% % %	8.18 1.0 6 34	5.48 1.0 4.98	6.5/4.67 1.0/0.9 3.5/2.42	NCRs for rework	Nos.			170/63
	Scrap	NA					Net Metal Scrap On all counts	Tonnes %Prodn			-/266 -/10.15
	Cp Improvement	To Compute					To Compute				
	Cpk Improvement	Carbon	Index	1.41	1.52	2/2.16	To Compute				
	Cust- Complaint	Carbon Metal	Nos. Nos.	2 17	0 16	0/0 0/13	Sales return as % of Dispatch	%	2.9	2.03	1.25/2.08
	ICSI	Monthly	0 - 10			8.0/7.89	Summery QCDIP	0 – 10			9.0/7.0
	ECSI	Carbon (Qrly) Metal (Monthly)	0 – 10 0 - 10			8.5/ 8.85 8 0/7.7	Customer rating	0 - 10			9.0/8.3
2	Cost										
	Process Techno. Up-grading	Capex Projects	Mio/Year			25/14.42					
	Maintenance Cost		Rs./MT	1874	1672	1600/ 1470.8	R & M Cost	Rs/Ton	1558	1573	1245/1638
	Energy Saving	Power	Kwh/Ton	127	183	150/ 167.45	Power Fuel	Kwh/Ton Ltr/Ton	1425	1488	1362/1497 101/101
	MP Design	MPD Projects	Mio/Year								
	Inventory Turnover (RM, WIP,FG)	RM WIP FG	Days Days Days	21 3 3	18 3 2	15/19.27 3/3 1/1.45		Rs(Crs.)			9/6.08
	Waste Elimination	Cases Eliminated Space@Rs1200/s ft Time@Rs255/M	Nos. Million/ year Million/			60/57 12/7.36 18/262	To Compute				

		II	year								
	Cost of Quality	Only Failure Cost	Mio			3.575 / 2.532 8 5 / -	To Compute				
	Kaizens Saving	FIP & QIP	Mio/Year			1 / 12.5	To Compute				
3	Delivery										
	Late Delivery Reduction	To Compute					Prodn. Backlog (2 weeks base)	% late			0 / 1.56
	OTIF delivery to Customers	Delivery Index	Ratio	0.83	0.86	0.92 / 0 944	Weekly Delivery	%			85 / 86
	OTIF delivery from Vendors	Delivery Index	Ratio	0.71	0.78	0.82 / 0 81	For Control Items	%			- / 97
4	Innovation										
	Kaizen per Employee		Nos.			2 / 1 85	Kaizen/Quarter	Nos.	0.1 6	0.28	- / 14
	Systems Simplified	BPR cases	Nos.			4 / 1.4	To Compute				
	Tech. Innovation		Nos.			8 / 2	To Compute				
5	Productivity										
	Manpower Produ.	Aluminium	Kg/MH			17 / 17 3	Mio Sq meter	Kg / MH		63.55	- /80.83
	Throughput Yield	To Compute					Total recovery	%	65	63	72 / 67.7
	Planned Shutdown	Carbon	Days/year	20	18	12 / 5	Down Time IIM Down Time CM-I Down Time CM-II	% % %	12	11.5	5 / 10.15 8 / 6.13 9 / 5.95
	MTBF Increase	Critical Equip				- / 178 75	To Compute				
	MTTR Reduction	Critical Equip				- / 7 917	To Compute				
	OEE Increase	Overall Plant	%	86.31	88.67	94 / 88 05	Utilization HM	%			- / 37.73
	Manufacturing Cycle Time	To Compute					All Products	Days		15.8	9 / -10.37

S N	Units →	Company 9 - Grasim Cement Raipur					Company 10 - Tanfac				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till Qtr.*
1	Quality					Tgt /Actual					Tgt /Act
	Process Defect	To review	NA				Quality Rate	%	5.1	4.08	0 / 2.93
	Reprocessing	To review	NA				Failure/Waste	%			
	Scrap	To review	NA				To review	NA			
	Cp Improvement	Clinker Litre Wt. Clinker Free Lime	Index, Index	1.01 -	0.90 -	1.33 / 1.0 1.33 / 2.27		Index	1	1	4 / 1
	Cpk Improvement	Clinker Litre Wt. Clinker Free Lime	Index, Index	0.7 -	0.53 -	1.0 / 0.67 1.0 / 1.92		Index	1	1	4 / 1
	Cust- Complaint	Customer Reports	Nos.	28	22	11 / 24	Customer Reports	Nos.	1	1	0 / 0
	ICSI	Surveys	0 - 10	5.69	5.96	7.0 / 6.32	Surveys	0 - 10	7.6	8.2	8.5/ 8.8
	ECSI	Surveys	0 - 10	6.42	7.78	8.0 / 7.31	Surveys	0 - 10	9.0	9.2	9.5 / 9.2
2	Cost										
	Process Techno. Up-grading	Annual	Rs.-Lacs	42.82	11.55	200 / 63 09	Process & IT	Rs (Lacs)	50	6	24 / 11.1
	Maintenance Cost	Contractor Store, Spare	Rs./MT	104.25	102.38	102 / 78.78	Contractor Store, Spare	Rs (Lacs)	36 9.3 1	310.05	255/291. 1
	Energy Saving	Power Fuel	Rs-Lacs Rs Lacs)	6.42 7.01	8.22 5.55	35.2/ 102.25 2.8 / 20 45	Power, Steam, Water Saving	Rs (Lacs	57. 05	5.34	55.7 /21.1
	MP Design						Design Change	Rs (Lacs)	1.1 9	9.32	12 / 1.68
	Inventory Turnover. (RM, WIP, FG)	Coal Slag Clinker Cement	Days Days Days Days	- - - -	22 14.08 17.29 2.43	15 / 22.76 15 / 16 31 10 / 18.51 2 / 1 72	RM+WIP+FG Turn over	Ratio	0.2 7	0.27	0.15 /0.23
	Waste Elimination	Cases Eliminated To Compute	Nos. Rs Lacs.	- -	- -	- / 21 108 / -	Cases Savings	No. Rs(Lacs)	17 17	8 15	90 / 27 18 / 7 0

	Cost of Quality	Sale Turnover	%		8.4	6.4 / 6.02	Total COQ	Rs(Lacs)	11.65	11.05	10 / 11
	Kaizens Saving		Rs Lacs.	5.14	10.9	- / 2.6		Rs(Lacs)	46.2	11.75	31.5/44.77
3	Delivery										
	Late Delivery	To Compute					Order to Dispatch	Days	4	2	2 / 2
	OTIF to Customer	Actual vs Target	%	88.17	99.31	100 / 88 25	Despatch Base	%	78	82	90 / 86 67
	OTIF from Vendors	Critical Items	%	45.28	45.07	75 / 66.02	Order to Receipt Lead Time	%	.58	65	78 / 73
4	Innovation										
	Kaizen/ Employee	Kaizen/Employee	Ratio.	0.21	0.28	0.50 / 0 28	Annual cases/Employee	Nos.	12.29	23	60 / 19
	Systems Simplified			-	-	- / 22	Process & Tool flow	Nos.	NIL	NIL	NIL / 2
	Tech. Innovation		Nos.	3	3	- / 11	Process, System & Cost	Nos.	2	1	1/1
5	Productivity										
	Manpower Productivity	Man Hour/MT Cement	Hrs/MT	1.89	1.62	1.5 / 1.44	Output per Employees	MT/Man/Month	255	281	311/305.3
	Throughput Yield	Utilization (Based on 1.8millionTPD)	%	71.14	78.07	100/ 82.62	Final Product vs Raw Material	Ratio	1686	1701	1708/1701
	Planned Shutdown	Kiln S/D	No/Month	1	0.5	0.5 / 0.91	Reduction (PM & Shutdown Hours)	Av. Hrs	519	402	380/311
	MTBF Increase	Model Area	Hrs	297.66	809.69	180/ 708 9	Av.Running Hrs.	Hrs	1533	2160	3240/3209
	MTTR Reduction	Model Area	Hrs	2.22	1.84	1.38/ 1.79	Av.Stoppage Hrs.	Hrs	3.12	3	2 / 2.533
	OEE Increase	Model Area	%	86.65	89.45	90 / 90.76		%	88.0	91.12	92 / 93 67
	Manufacturing Cycle Time	To Compute					To review	NA			

SN	Units →	Company 11- Essel Mining, Vapi (Ferro Chem.)					Company 12 - Essel Mining, Jagdishpur (Quality Packaging)				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till Qtr.*
1	Quality					Tgt /Actual					Tgt /Actual
	Process Defect	Generation of Slag in Fero-Molybdenum Fero-Vanadium	% %		4.47 1.74	2.25 / 4.64 0.87 / 1.94	To Compute	NA			
	Reprocessing	Recharge of Slag in Fero-Molybdenum Fero-Vanadium	% %		100 100	- / 71.1 - / 69.4	Tape Side Film & Un stretched tape	%	1.1	1.25	1.5 / 1.75
	Scrap	To review			NIL	- / NIL	Tape Wastage	%	10.97	9.25	7.5 / 7.97
	Cp Improvement	Fero-Molybdenum Fero-Vanadium	Index Index			1.0 / 0.32 1.0 / 0.57	To Compute	NA			
	Cpk Improvement	Fero-Molybdenum Fero-Vanadium	Index Index			1.0 / 0.32 1.0 / 0.57	To Compute	NA			
	Cust- Complaint	Defect Qty/Sale	%		1.12	0.75 / 0.912	Customer Report	Nos.	10	10	10 / 29
	ICSI	To Compute					Surveys	0-10	7.5	7.7	- / 7.0
	ECSI	To Compute					To Compute				
2	Cost										
	Process Techno. Up-grading	Process Modification	Rs.(Lacs)		23.66	70.28/ 44 75	Tape Slitting Unit	Rs (Lacs)		0.5	- / 1.2
	Maintenance Cost	R & M Cost	Rs/Ton		1350	1335 /	Contract & Spare	Rs (Lacs)	71.55	66.87	50/43.85

						1338					
	Energy Saving	To prioritise					To Prioritise				
	MP Design	Alloy Plant Blower	Rs (Lacs)			-/0.80	To Compute				
	Inventory Turnov. (RM, WIP,FG)	Turnover Ratio	Rs (Lacs) Ratio			-/13.06 -/0.077	Raw Material Proress Stock Finished Goods	Rs (Lacs) Rs (Lacs) Rs (Lacs)	112 117.7 37.82	131.2 8 51.88 98 61	-/ 228.04 -/19.65 -/67 16
	Waste Elemination	Cases Savings			8	-/ 52	Cases Savings	No. Rs(Lacs.)	4 0.0	4 1.72	5/5 1.25/1.2 8
	Cost of Quality	Total COQ	Rs.(Lacs)			-/ 77.72	Total COQ % Sale	Rs.(Lacs) %			-/ 171.31 -/6 67
	Kaizens Saving					-/2.35		Rs(Lacs)			129.91/2 6
3	Delivery										
	Late Delivery	To Compute						NA			
	OTIF delivery to Customers	For Late Payment Manufa. Problem	% %			2/3.77 0/0 05	Actual/Target	%	100	100	100/ 100
	OTIF delivery from Vendors	Late Qty. receipts vs Total Qty	%			-/3.50	For Critical Items	%	70	75	90/80
4	Innovation										
	Kaizen/ Employee		Nos.		0.337	2.5/ 2.175	Kaizen/Employee	Ratio.	0.10	0.11	0.12/ 0.12
	Systems Simplified		Nos.			-/1	Improve. Themes	Nos.	6	8	10/10
	Tech. Innovation		Nos			-/5	Project. Themes	Nos.	4	4	6/6
5	Productivity										
	Manpower Productivity	Production base	MT/Man		9.75	11/ 11.02	Production base	MT/Man	7.89	8.20	8.5/8.5
	Throughput Yield	Ferro Molybde. Sludge to V2O5 V2O5 to Fe-Van	% % %		98.02	-/97.92 -/97.88 -/94.78	Capacity Utilize	%	90	89.4	90/ 89.5
	Planned Shutdown						Tape Plant	Hrs	325	312	300/295
	MTBF Increase	For Critical Equip.	Hrs			70/ 59.19	Tape Plant	Hrs	135	140	200/196
	MTTR Reduction	To Compute					Tape Plant	Hrs / BD	4.36	2.79	2.75/2.7 8
	OEE Increase	For Critical Equip	%		57	85/ 83	Tape Plant	%	75	85	85/83.5
	Manufacturing Cycle Time	V2O5 Ferro-Vanadium	% %			-/25 -/25	To Compute				

SN	Units →	Company 13 - Indal, Muri Works					Company 14 - Bihar Caustic & Chemicals Ltd.				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till Qtr.*
1	Quality					Tgt /Actual					Tgt /Actual
	Process Defect	NCRs raised	Nos.	10	9	0/8	To Compute	NA			
	Reprocessing	Customer Return	%			0/0	To Compute	NA			
	Scrap	NA					To Compute	NA			
	Cp Improvement	To Compute					To Compute	Index Index			
	Cpk Improvement	To Compute					To Compute	Index Index			
	Cust- Complaint	Product Quality	Nos.			-/0	To Compute	Nos			
	ICSI	QCDIP Opr Team	0-10			9.0/6.9	To Compute	0-10			
	ECSI	Chemical Business	0-10			-/7.8	To Compute	0-10			
2	Cost										
	Process Techno. Up-grading	To Prioritise					To Prioritise	NIL			
	Maintenance Cost	Including Kaizen	Rs./Ton	413	395	476/388	Caustic Plant Power Plant	Rs (Lacs) Rs (Lacs)		242.61 -	248 64/225 67.56/86.11
	Energy Saving	Power (Hydrate)	GJ/Ton	11.86	11.59	11.59/	Caustic Plant	Kwh/Ton		3139	3200/

		Coal (Alumina)	Ton/Ton	0.84	0.76	11.49 0 672 / 0 67					3173
	MP Design	To Prioritise					Saving Projects	Rs (Lacs)		58.03	- / 0.83
	Inventory Turnover (RM, WIP, FG)	Inventory/Sale based	Ratio	0.11	0.12	0.17 / 0.10	Raw Material Work in Process Finished Goods	Rs (Lacs) Rs (Lacs) Rs (Lacs)		20.99 624.7 3 122.2 8	19.07/28 .69607.3 /553.2 70.89/81 .53
	Waste Elimination	Cases (To Report) Savings	No. Rs (Lacs.)			- / 0.271	Cases Savings (Annual)	No. Rs(Lacs.)		64 9.25	- / 21 - / 10.31
	Cost of Quality	To Compute					To Compute				
	Kaizens Saving	One Time Pragati Recurring (annual)	Rs.(Lacs.) Rs (Lacs)			- / 4.168 - / 7 95	Since WCM Launch	Nos. Rs(Lacs)			- / 267 - / 17.87
3	Delivery										
	Late Delivery Reduction							%	NIL	NIL	0 / NIL
	OTIF delivery to Customers	Clear Sale Order base	%	92.2	90.6	95 / 97.93	Caustic Chlorine HCl	% % %		100 100 100	100 / 100 100 / 100 100 / 100
	OTIF delivery from Vendors	To Compute					Raw Material Stores Supplier	% %		- -	90 / 88 70 / 71
4	Innovation										
	Kaizen /Employee	Kaizen/Per month	Nos.			100 / 15	Kaizen/Year	Nos.		105	- / 5
	Systems Simplified	To Prioritise					Functional Process Themes	Nos.			- / 21
	Tech. Innovation	To Prioritise					To Prioritise	Nil			
5	Productivity										
	Manpower Productivity	Annual Hydrate Production Base	MT/ Man yrs	122	137	153 / 149	Caustic Production Base	MT / Man day		82.31	- / 86.99
	Throughput Yield	To Compute					Caustic Plant	Ratio.		0.159	- / 0.134
	Planned Shutdown	Up Time	%	97.8	97.8	98.5 / 98 0	To Compute				
	MTBF Increase	To Compute					Caustic Plant Power Plant	Months Months			- / 1.78 - / 4.11
	MTTR Reduction	To Comprte					Critical Equip.	Hrs			
	OEE Increase	Kiln # 2	%			82.1 / 79 46	Critical Process	Av. %			- / 84.82
	Manufacturing Cycle Time	To Compute					To review				

SN	Units →	Company 15 - Aditya Cement					Company 16 - Thai Carbon Black Public Co.				
	Indicators	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till date*	*Item / Area Details*	*Unit of Measure*	*1999-2000*	*2000-2001*	*2001-Till Qtr.*
1	Quality					Tgt /Actual					Tgt /Actual
	Process Defect	Non Confirming Product (Specified)	%	0.035	0.009	0.00045 / 0 00054	To Compute				
	Reprocessing	To review	NA				To Compute				
	Scrap	To review	NA				To Compute				
	Cp Improvement	Raw Mill	Index			1.0 / 0 74	To Compute				
	Cpk Improvement	Raw Mill	Index			1.0 / 0 74		Index	0.92	0.97	- / 1.3
	Cust- Complaint	Market Report	Nos.	27	20	5 / 12	Cust. Complaint	Nos./Yr	24	20	24 / 6
	ICSI	To Compute	0 - 10	-	-	- / -	To Compute				
	ECSI	To Compute	0 - 10	-	-	- / -		0 - 10	3.7	4.0	- / 4.1
2	Cost										
	Process Techno Up-grading		Rs (Million)	78.4	80.4	150 / 126 8	To Prioritise				

	Maintenance Cost		Rs/Ton	90.73	92 95	75 / 80 44	CII Production	Baht/MT	294	257	244 / 263
	Energy Saving	Utilities & Energy	Rs /Ton	239.94	275.04	250 / 261.24	To Prioritise				
	MP Design		Rs. (Million)	42.4	45 8	20 / 35.5	To Prioritise				
	Inventory Turnover (RM, WIP,FG)	Total turnover of Inventory	Rs /Ton	410.09	382.02	360 / 380 96	Product Inventory				
	Waste Elimination	Cases Savings	No. Rs (Lacs)	34 28 5	25 15 6	20 / 15 7.5 / 8 7	To Compute				
	Cost of Quality	Total COQ	RsMillion			200 / 239 94	To Compute				
	Kaizens Saving	QC Themes	RsMillion	544.9	501.13	700 / 627.1	To Compute				
3	Delivery										
	Late Delivery Reduction	To Compute									
	OTIF delivery-to Customers	Cement Dispatch	MT	1400140	1363644	1450000 / 1434229	On Time Delivery	%	100	100	- / 100
	OTIF delivery from Vendors	Raw Material	MT	361988	321268	400000 / 369435	To Compute				
4	Innovation										
	Kaizen per Employee	Total Kaizen	Nos.	32	45	60 / 54	Total Kaizen	Nos	150	240	- / 490
	Systems Simplified		Nos.	26	37	50 / 44	To Prioritise				
	Technological Innovation		Nos.	6	8	12 / 10	To Prioritise				
5	Productivity										
	Manpower Productivity	Production Base	MT/Man	2926	2946	3300 / 3175		MT/Man	525	539	544 / 562
	Throughput Yield		TPH	175.14	176.57	220 / 214.7	MTCBFO/MT	Ratio	1.722	1.746	1.730/1.721
	Planned Shutdown	Kiln	Hrs	138	1222	138 / 1967	Breakdowns	Nos/Year	26	30.4	18.3 / 2.5
	MTBF Increase	Kiln	Hrs	165.1	319	300 / 167		Hrs.	230	350	- / 370
	MTTR Reduction	Kiln	Hrs	3.23	7.55	2.57 / 2 67		Hrs.	3.0	4.2	- / 3.0
	OEE Increase	Kiln	%	82	83	95 / 92	OPE (Plant)	%	99.0	99.5	- / 99.8
	Manufacturing Cycle Time	Polycom bypass	Hrs	1.5	-	1 / -	To Prioritise				

Table 4.1: WCM Performance Indicators from some of the Group Units

(At several places in the table above, a lot of figures had to be left blank because of unavailability of the methods of measurements at present stage in the particular industries. The designed format for the measurement of the WCM Key Indicators is not industry specific and is generic in nature based on the concepts of QCDIP. Some of the parameters as mentioned in the format are new for the industry hence the measurement is yet to start

4.3.2 BRIEF ANALYSIS OF RESULTS

(Only Seven Cases have been presented below to give a fair idea of representation of the results)

1. Unit: Grasim SFD, Nagda

A) Performance Summary

- Process Defect Rate & Scrap rate show downward trend though Reprocessing Rate is going high. This is because of High Product Defect (DPMO) and low Process Capability.
- There is constant effort towards Technological Up-gradation with substantial savings. Savings through Energy, MP Design, Kaizen, Waste Elimination, and Maintenance Cost control are appreciable.
- Inventory during 2000-01 is high because of extra stocking, and financial overlapping.
- The COQ is in increasing trend because high Failure/Appraisal/Prevention Cost. More critical considerations are being given to reflect distinct area for improvement.
- Though Manpower Productivity and OEE are in increasing trend, there was adverse impact on MTBF & MTTR, which has improved this year.

A) Lesson Learnt/Disappointments:

- Convert hazardous waste (Fly Ash) into high utility (Bricks)
- Generation of Bio-gas from Dairy Effluent
- Conserve water

B) Special Efforts for Implementation:

- Drinking water facility to 20 villages, schooling up to class XII
- Reproductive health care and Social welfare
- Internet & E-mail facility
- Energy conservation ventures
- Senior managers act as Role Models by taking ownership of area/equipment
- ISO 14001 & ISO 18001 accreditations

C) Savings Achievements (Cumulative 3 years):

	Rs (Lacs.)	UK (£) in million
o Process Technology Up-gradation:...	270.76	0.38
o MP Design	657.0	0.92
o Kaizen & Focused Improvements...	2036.	2.85

2. Unit: Birla Cellulosic

A) Performance Summary

- Reduction in Process Defect Rate and there is continuous improvement in Process Capability.
- Internal Customer Satisfaction Index is improving. The Customer Complaints rates are increasing though the External Customer Satisfaction is increasing. This increase in Customer Complaints may be attributed to the presence of new competitors. The expectations of the external customers have increased.
- There is constant effort towards Technological Up-gradation with substantial savings. Savings through energy conservation, MP Design, Kaizen, and waste elimination are appreciable. The maintenance cost is maintained at a steady level.
- Inventory turnover ratio is being maintained at a constant level.
- The COQ computation has been reflected as percent of total of cost of quality itself.
- Correct computation method is being followed to access easy identification and control.
- Though Manpower Productivity and OEE show no incremental change, there is marked improvement in MTBF & MTTR. The Manufacturing Cycle Time also show reduction trend.

B) Lesson Learnt/Disappointments:

- Conserve water

C) Special Efforts for Implementation:

- ISO 14001 & ISO 18001 accreditations

D) Savings Achievements (Cumulative 3 years):

	Rs (Lacs.)	UK (£) in million
o Process Technology Up-gradation:...	160.78	0.23
o MP Design	18.42	0.026
o Kaizen & Focused Improvements...	578.0	0.81

3. Unit: Thai Polyphosphate & Chemicals Co. Ltd.

A) Performance Summary:

- Process defect rate has continuously reduced and there is continuous improvement in process capability.
- Customer complaints are gradually going down which is an indication of reduced scrap rate as evident in the performance indicator.
- Savings through Energy, MP Design, Kaizen, are appreciable. The Maintenance Cost is controlled.
- Inventory turnover ratio is being maintained at constant level.
- The Manpower Productivity and OEE show incremental change. There is marked improvement in MTBF & MTTR. The Manufacturing Cycle Time also show reducing trend.

B) Lesson Learnt/Disappointment:

- Conserve water

C) Special Efforts for Implementation:

- ISO 14001 & ISO 18001 accreditations

D) Savings Achievements (Cumulative 3 years):

	Baht (Lacs.)	UK (£) in million
o Energy recovery & utilization...	355.00	0.570
o MP Design	4.21	0.0068
o Kaizen & Focused Improvements...	177.10	0.285

4. Unit: Grasim, Cement Raipur

A) Performance Summary:

- Process Capability shows an increasing trend with lesser defects and higher Customer Satisfaction. Customer Satisfaction is improving marginally but Customer Complaints are reducing.

- There is a constant effort towards Technological Up-gradation with substantial saving. Savings through Energy, Kaizen, Waste Elimination are appreciable.
- Inventory and Maintenance Costs are maintained at a constant level.
- The COQ is in decreasing trend showing improvement in quality and reduction in re-work.
- The Manpower Productivity and OEE are in increasing trend. There is clear indication of impact on MTBF & MTTR, which are also improving.

B) Lesson Learnt/Disappointments:

- Bag quality analysis for creating edge on competitors.
- Mobile Concrete Test Labs help in building up customer's confidence.
- Exclusive educational program on design of appropriate Concrete Mix for optimal use at the user's end helps improve business.
- Work with Quality Bench-Marking to cater to market demand.

C) Special Efforts for Implementation:

- Spread literacy & Education to consumers.
- Income generation schemes and welfare schemes for neighbouring villages.
- Establishing Mobile Concrete Test Lab.
- Multi-skilling in every Area & every Zone.
- Empowerment of Under-privileged through self employment
- Energy conservation ventures
- Senior managers act as Role Models with ownership of Area/Equipment
- ISO 14001 & ISO 18001 Accreditations

D) Savings Achievements (Cumulative 3 years):

	Rs (Lacs.)	UK (£) in million
Process Technology Up-gradation:	102.63	0.144
Energy recovery & utilization...	149.9	0.210
Kaizen & Focused Improvements...	195.74	0.274

5. Unit: Bihar Caustic & Chemicals Ltd.

A) Performance Summary:

- Customer Satisfaction is improving.
- Savings through Energy, MP Design, Kaizen, Waste Elimination are appreciable
- Manpower Productivity and OEE shows increasing trend. The MTBF & MTTR also show improving trend.

B) Lesson Learnt/Disappointments:

- Convert hazardous waste (Fly Ash) into high utility (Bricks)
- Arrest HCl fume and reuse in process to curb the pollution.
- Morning prayer made compulsory to bring discipline and harmony in the organization.

C) Special Efforts for Implementation:

- Drinking water facility to 20 villages, schooling up to class XII
- Reproductive health care and Social welfare.
- Modernization by change of technology from mercury to membrane cells.
- Energy conservation ventures.
- Senior managers act as Role Model with ownership of area/equipment
- ISO 14001 Accreditations.

D) Savings Achievements (Cumulative 3 years):

	Rs (Lacs.)	UK (£) in million
Energy recovery & utilization...	10225.44	14.31
MP Design	58.86	0.082
Kaizen & Focused Improvements...	17,87	0.025

6. Unit: Thai Carbon Black Public Co., Ltd.

A) Performance Summary

- Customer Satisfaction is improving. Customer complaints are reducing. The On Time Delivery is improving.

- Savings through Energy, MP Design, Kaizen, Waste Elimination, and Maintenance Cost control are appreciable.
- Throughput Yield is improving with increase in Manpower Productivity.
- The MTBF & MTTR are well controlled and show improvement

B) Lesson Learnt/Disappointments:

- "You may be driving car in any part of world, and there is good possibility that your tyre have used carbon black of TCB"
- Condition monitoring & CMMS bring effective impact on PM

C) Special Efforts for Implementation:

- Energy conservation ventures
- Senior managers act as Role Model with ownership of area/equipment
- ISO 9002 & ISO 14001, QS 9000 Accreditations

7. Unit: Aditya Cement

A) Performance Summary

- Customer Compiaints are reducing
- There is constant effort towards Technological Up-gradation with substantial saving. Savings through Energy, Kaizen, and Waste Elimination are appreciable.
- Inventory and Maintenance Costs are maintained at a constant level.
- The Manpower Productivity and OEE are in increasing trend. There is clear indication of impact on MTTR, which is also improving.

B) Lesson Learnt/Disappointments:

- 100% On line documentation.
- Quality focused approach to cater tomarket demand.

C) Special Efforts for Implementation:

- One to one interaction with senior executives.
- Skill Development

- Energy conservation ventures
- Senior Managers act as Role Model with ownership of area/equipment
- ISO 9001 & ISO 18001 Accreditations

D) Savings Achievements (Cumulative 3 years):

	Rs (Lacs.)	UK (£) in million
○ Process Technology Up-gradation: … … …	2856.00	3.99
○ Energy recovery & utilization… … … … …	1572.48	2.20
○ Kaizen & Focused Improvements… … … …	16731.30	23.42

5.4 SAVINGS THROUGH WCM DEPLOYMENT

SN	Parameters	Cumulative savings (Rs. in Lacs.)	Savings: UK £ in millions
1	Waste Elimination	12093.9	26.66
2	Kaizens	19043.0	16.93
3	Quality Improvement Projects	1578.9	2.21
4	5 S	500.0	0.70
5	MP Design	458.4	0.64
6	JIT	282.9	0.40
7	COQ	163.8	0.23
	Total	**34120.9**	**47.76**

Table 4.2 – Cumulative Savings through WCM implementation since 1997 - the year in which WCM was launched in The Aditya Birla Group of Companies

These figures are over a period of nearly 5 years. Thus, on an average there are savings of about 9.5 millions UK £ per year. The turnover of the group is about 5500 millions UK (£). The savings comes equivalent to about 0.2 % of the Group's turnover which is quite an impressive figure. **(Refer VCD-2 (A), Exhibit-V4.1, Kaizen Cases Presentation)**

Highest savings were achieved through wastes eliminated (under the 12 categories of Waste). *These figures are different from those as mentioned under JIT and Kaizens. All these categories of savings are due to the successful deployment of the dimensions of the Author's WCM Model. Savings through Kaizens are those, which have been achieved after the successful implementation of ideas/suggestions by operating and project teams. The Kaizens, which were successfully implemented in the field, were analysed for potential MP (Maintenance Prevention) Design projects. The savings as mentioned in the above table under the category of Quality Improvement Projects, refers to projects undertaken and successfully executed by the Project Teams. These projects have been identified and completed over and above the normal activities of WCM implementation. These projects were basically to improve the Critical to Quality (CTQ) characteristics identified after the analysis of the Customer Satisfaction survey reports.*

4.5 INTANGIBLE RESULTS

4.5.1 ZERO ABNORMALITY WORK CULTURE

One of the greatest achievements due to the Cultural Transformation achieved through the proliferation of the WCM initiative in an Organization is the **"Zero Abnormality Movement."**

Another major achievement due to Cultural Transformation through WCM is the instilling and inculcating of the feeling of **Ownership and Teamwork amongst the Workforce.**

The Results are depicted in the following photographs:

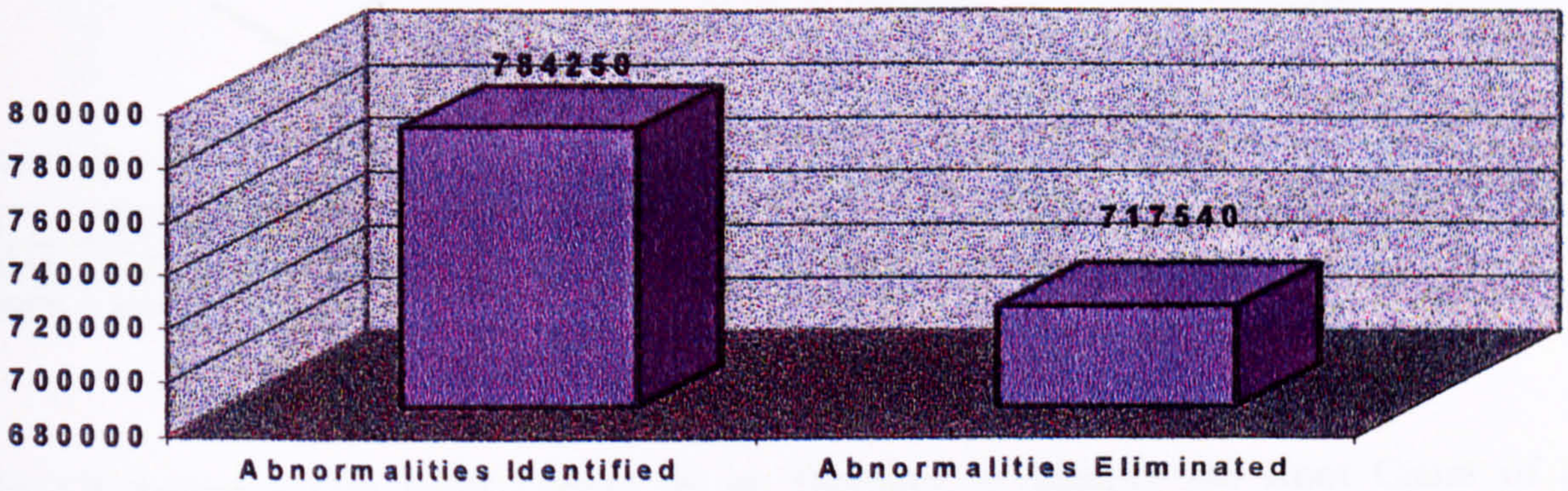


Fig 4.1: Status of Abnormality Management as on March, 2002

JAYASHREE TEXTILES (JST)

FABRIC DYE HOUSE

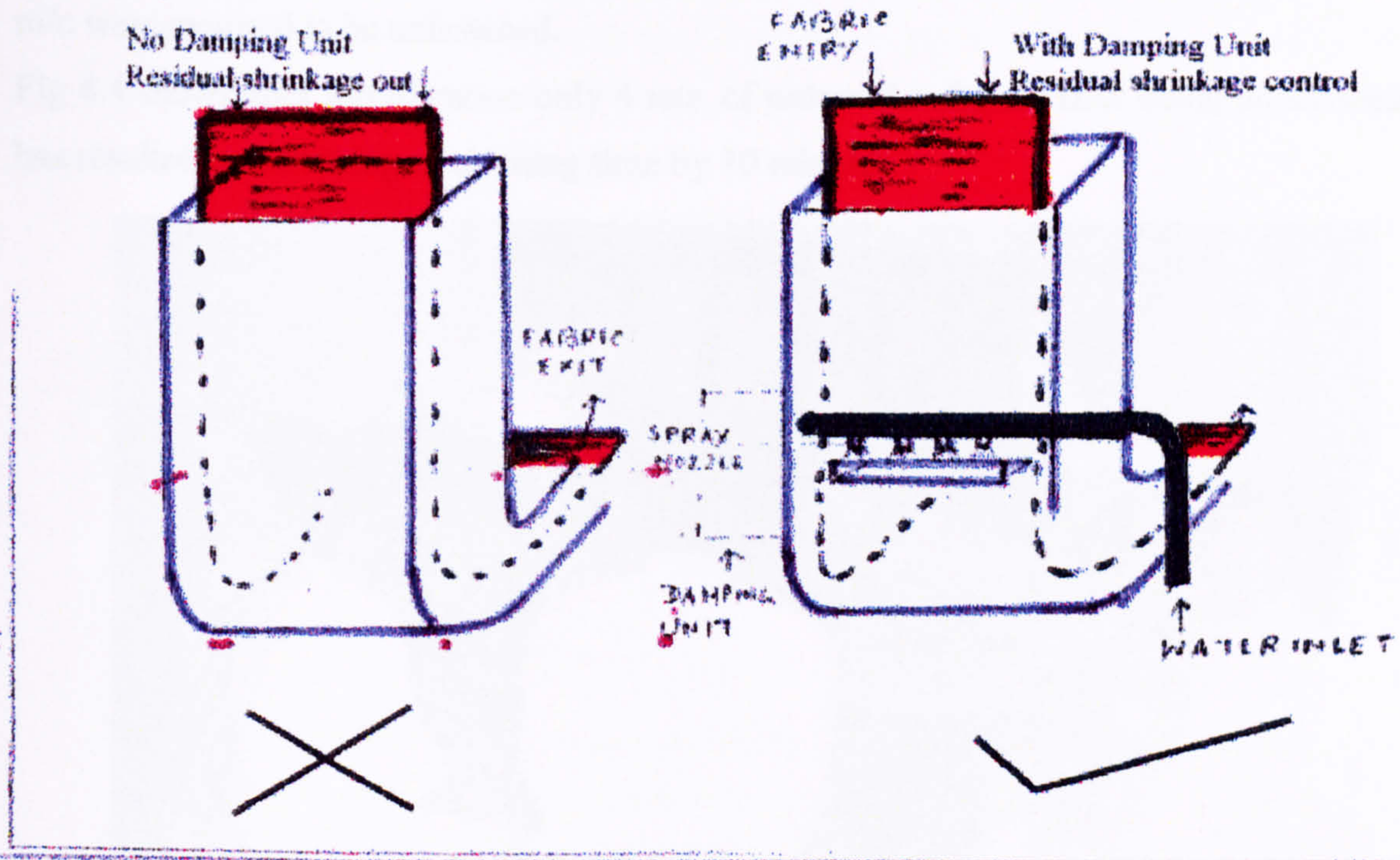
ONE POINT LESSON

DATE OF PREPARATION: *22/09/2000*

THEME: ***To control residual shrinkage in Zero-Zero M/C***

Why Why Analysis	Answer	Result
Why Residual shrinkage is out?	**Shrinkage is not properly imparted on the dry fabric**	
Why shrinkage is not properly imparted on the dry fabric?	**Because slight moisture swells the natural fibre and increases fibre flexibility and imparted shrinkage is properly set in the fabric in Post-drying by Palmer cylinder.**	**To arrange for pre-damping/ moistening unit in Zero-Zero**

POINTS TO CHECK :-



*** ACTUAL RESULT**

Date	**22/09/2000**			
Teacher	***U.K.Chandra***			
Students	***Madan, Nageshwar***			

Fig 4.2: One Point Lesson of a Textile Unit

Fig 4.2 depicts a One Point Lesson by an Operator to identify the Root Cause of an Abnormality through the application of Why – Why Analysis.

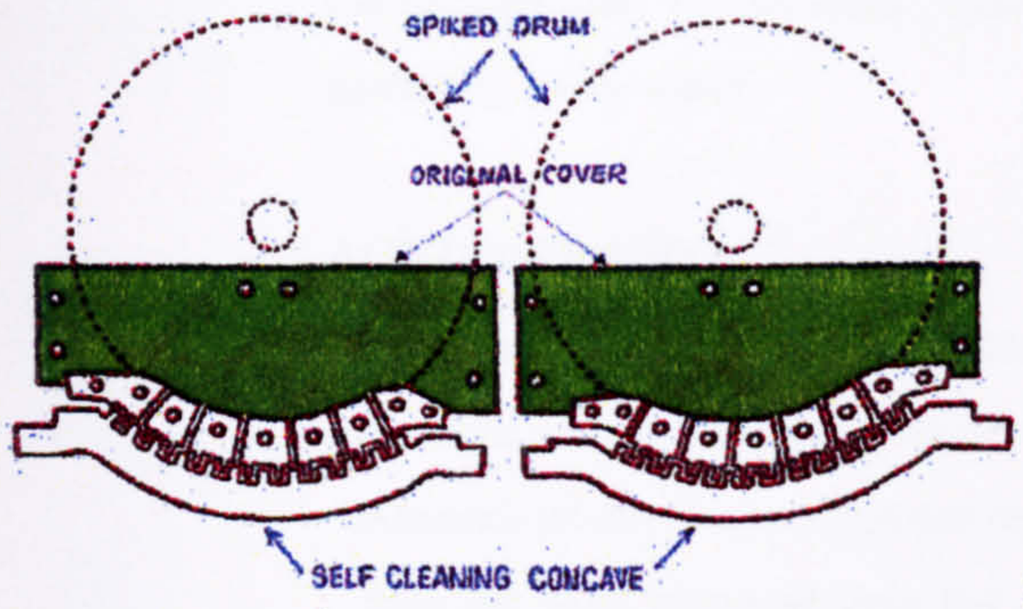


Fig 4.3

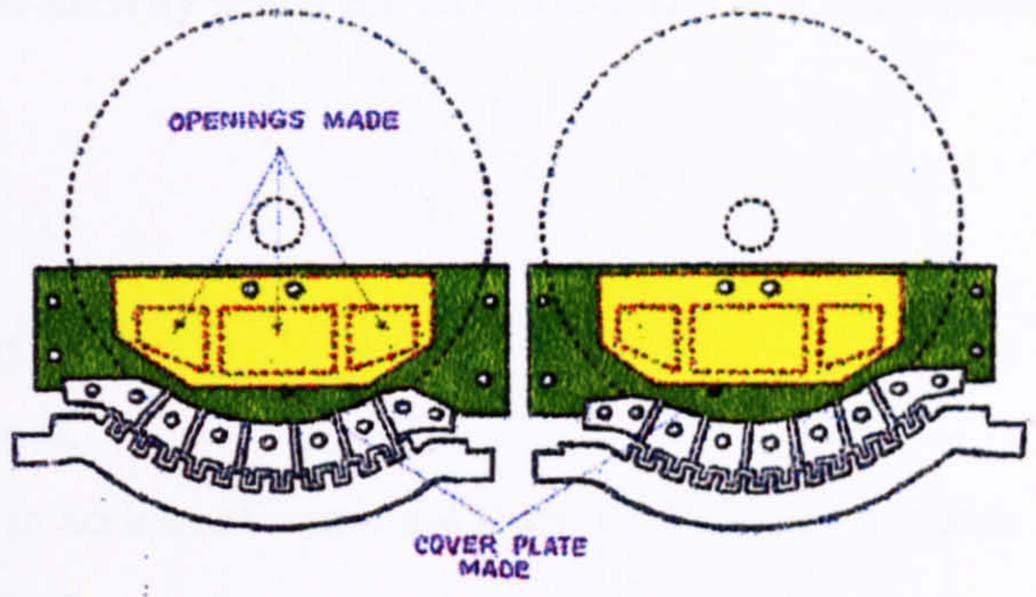


Fig 4.4

One Point Lesson Example: Before and After Kaizen

Fig 4.3 shows the Before Modification stage OF HARD TO ACCESS AREA OF SCOURING DOUBLEDRUM OPENER. Here, 44 Nos. of nuts and bolts of the covers in one side of the m/c were required to be unfastened.

Fig 4.4 shows after Modification only 4 nos. of nuts and bolts are now being unfastened. This has resulted in the saving of cleaning time by 30 minutes.

Fig 4.5: Glimpse of a Team Meeting

Fig 4.5 shows an area of shared responsibility, a place to meet to discuss the progress and plans by team. An **Activity Board** containing display of Team performances could be seen in

the background. Teams meet , discuss their activity status for 10 -15 minutes at a fixed timing generally every week.

ACHIEVEMENTS

- Excellent Rapport with the concerned authorities.
- Periodic communication with all employees.
- Absence of any major disputes resulting in no loss of man-days since 1997. Minor disputes entailed work stoppage only for a few hours.
- Most of the disputes are settled on bi-partite level.
- Absenteeism is less than 3% - much below industry average.
- Number of accidents reduced significantly.
- Smooth rationalization of workforce without any loss of Man days.
- Improvement in Organizational Health
- Spontaneous participation in small group activities like Kaizen, Quality Circles etc.
- Dissemination of knowledge through periodic participation in various seminars of institutes for professional learning.
- Industrial Training/Summer projects for final year students of CA, MBA, and Engineers.
- One and half mandays training for all employees
- Training for Multi-skilling of majority of the employees
- Timely Submission of all Returns
- Regular interaction with the Authorities at all levels
- Participation in various programs, Workshops of Government / Institutions
- Patronizing 'Thursday Club' - an informal association between Industry and Authority for all round improvement

Author believes that a Safe, Healthy, Clean and a Hygienic Work Environment form the building block of any improvement initiative. Taking cue from this brief discussion and appreciating the efforts of the Manufacturing Plants in this direction, the author feels proud to present below a few photographs depicting the results of such an effort. The manufacturing unit whose photos appear below are from one of overseas Textile Units. These photos bring out in a very effective manner the impact of efforts by a Unit to improve its Work Environment.

Fig 4.6: Scrap Yard Before implementing 5S

Fig 4.7: Scrap Yard After implementing 5S

Fig 4.8: Scrap Yard Before implementing WCM

Fig 4.9: Scrap Yard After implementing WCM

Fig 4.10: Table Drawer Before implementing WCOM Practices

Fig 4.11: Table Drawer After implementing WCOM Practices

4.5.2 EFFECTIVENESS OF WCM INITIATIVES

- A new Culture has been brought in e.g. Small Group Activities
- Concept of Ownership of machine – "It is our job, our machine, Let US do it together."
- WCM has helped in developing Positive Attitude – "I can do it, I do it better and I can help others as how to do it."
- WCM has helped in developing a new Innovative Skill among employees – number of Kaizens and One Point Lessons.
- Now people are open to Multi-skill training – Their fear has gone.
- Most important, all employees realise that if they have to exist in business, they have to be a cost effective producer

The WCM initiative has also initiated certain Good Practices. Some of them are:

Morning exercise everyday attended by all including the Chief Executive of the Organization followed by Team meetings

Starting of any function with prayer

Practice of giving individual names to Teams – Proud of being a part of Team

Reward and recognition schemes

Mass Communication Meetings

(Refer VCD-2(A), Exhibit-V4.2, Interview with workers, **VCD-2(B) Exhibit-V4.3,** Employees Passion for Excellence, **Exhibit-V4.4,** WCM Theme Song), **(Refer CD-1, Exhibit-4.29,** Cover Page of In-house Journal 'Belur Almanac'-A Respect for Excellence and Comparison of the Author to Mahatma Gandhi)

CHAPTER – 5

WCM & CONTEMPORARY QUALITY INITIATIVES – A COMPARISON

5.1 INTRODUCTION

With so many initiatives existing across the Globe today it becomes imperative to have an initiative which covers the major aspects of all initiatives without compromising on its own unique implementation methodology. This is of vital importance as such an initiative would eliminate any cause for confusion. Moreover, such an initiative would be quite generic in nature as it would invariably cover all manufacturing setups.

WCM is one such initiative, which covers majority of the aspects as mentioned above under its umbrella.

The following discussion will be helpful in comparing and contrasting all major contemporary quality and manufacturing processes related improvements (as already discussed in Chapter 2) with WCM.

5.2 WCM AND ACTIVITY BASED COSTING

Cost is a very complex field of study. However, a basic understanding of cost is necessary in order to become smart while buying.

Ohno Taiichi advocated the simple formula;

1. Selling price - Cost = Profit
2. Cost = Selling price – Profit
3. Selling price = Cost + Profit

Though at first sight, these appear to be same, but Ohino described this illusion as **Arithmetic's blind spot.** He puts formula No.1 as competition around and the selling price is determined by a third party. The task of reducing the cost to increase profit is within the control of the manufacturer.

Formula No.2 however, implies that once an item has been manufactured at a certain cost, the manufacturer must find way to make certain profit that he has targeted. Formula No.3 implies that a certain cost has been incurred; given a desired profit margin, the selling price can be arrived at. (Refer book: Ohno, Taiichi (1992), *Workplace Management*, Productivity Press, Madras.)

In today's competitive world the selling price is determined by the market and is not in complete control of the seller. Therefore, the only way a manufacturer/ seller will be able to increase his profit is through the reduction in the operating costs.

Though, Activity Based Costing, measures processes and is quite suitable for measurement and estimation of operations cost yet it lacks the holistic approach. It is void of all the soft parameters like Morale and Productivity and therefore is not very appropriate for overall improvement in any Organisation. It is purely a Costing technique and not an initiative in itself.

WCM on the other hand is an initiative in itself. It is a comprehensive integration of the 'Best of the Best'. The WCM approach encompasses the best of all the Tools and Techniques available in the World today without compromising on Costs. It basically operates on the philosophy of QCDIP. According to the QCDIP philosophy, the Customer deserves a Product or a Service which is Best in Quality, Low in Cost and Delivered on Time in full. This will be possible only through Innovation and will finally result in a high level of Productivity.

5.3 WCM AND VALUE ENGINEERING

Value Engineering is a process and operates on the functional analysis of the product rather than the physical, characteristics of a system. By use of Value Engineering one can expand the design scope so that the least costly alternative can be chosen.

Although Value Engineering is a process in itself yet the approach is neither people driven nor system driven. Its strong focus on Cost Reduction disqualifies Value Engineering as a generic method for evaluating Quality.

WCM philosophy, on the other hand takes a balanced approach to People, Processes, Systems and Cost. This enables WCM to handle any Quality Improvement or Manufacturing Processes improvement issues. WCM pays special attention to the Customer. In WCM methodology, there is a strong emphasis on both the stated and implied needs of Customer. Furthermore, the WCM approach is far more comprehensive than the approach adopted in Value Engineering.

5.4 WCM AND BUSINESS PROCESS REENGINEERING (BPR)

In BPR the current process is mapped with the ideal state of the process. All the Non – value adding activities are removed and if need be, the new state may be enabled and made more efficient through use of Information Technology. Though the scope of BPR is more than Value Engineering yet there are no specific guidelines on how to re-engineer the Business Process.

WCM on the other hand has laid down specific guidelines on its Methodology of Implementation without being too instructive. Thus there is enough scope for being both creative and flexible. Unlike WCM, BPR is a just a methodology and not an initiative in itself.

"An ERP system has modules for financial accounting, MRP/CRP, Purchasing, Human Resources, Shop floor Control, Sales and Distribution. It supports customer-oriented material and information flows, and can serve as a template for Business Process Re-engineering (BPR). In fact, one of the factors, which led to the phenomenal growth of ERP, was the popularity of BPR in the early 90s." (Refer book: Sahay B S, Saxena K B C, Kumar Ashish (2000), *World Class Manufacturing – A Strategic Perspective*, Macmillan India Ltd., Delhi.)

5.5 WCM APPROACH AND TOTAL PRODUCTIVE MAINTENANCE (TPM)

When a process is highly automated, two of the largest cost drivers are machine ineffectiveness and line downtime. They are related. A system of maintenance known as **Total Productive Maintenance** greatly increases machine effectiveness and line throughput. By using the operators to maintain the machines, large cost savings are realised.

In Production Environment, the criterion where Quality comes first is met by ***Total Productive Maintenance.***

To increase the effectiveness of Total Productive Maintenance it has to be integrated with the focus on business processes. This could only be done by integrating it with WCM. Though TPM takes care of People, Processes, Systems and Methods yet it does not deal exhaustively with Inventory Reduction and the Business Processes in totality. The TPM focus, is especially on Manufacturing Processes and not on Business Processes as a whole.

WCM on the other hand focuses both on Manufacturing and Business Processes. TPM gives special emphasis on Equipment and Equipment related Processes, whereas WCM takes the total picture into consideration and considers Manufacturing Processes as well as Business Processes and the interacting factors between the two types of Processes.

5.6 WCM AND TOYOTA PRODUCTION SYSTEMS

The Toyota Production System is a manufacturing process model developed by Toyota that led to their dominance in the auto industry. This production approach enabled Toyota as well as many other companies to achieve major improvements in productivity and quality.

"Ohno gives the credit for the term JIT to Toyoda Sakichi's successor, Toyoda Kiichiro: 'The words "just-in-time" pronounced by Toyoda Kiichiro were a revelation to some Toyota people, one of whom became quite attached to the idea." (Refer book: Ohno, Taiichi (1992), *Toyota Production System: Beyond Large-Scale Production*, Productivity Press, Madras.)

The Toyota Production System was built on three key factors that differentiated it from practices being employed by their competitors in the auto industry:

This system has been so successful that its methods are frequently imitated, and the approach has been applied in the areas of Product Development, Service Delivery, and Business Management Systems.

From the above discussion it is seen that Toyota Production Systems (TPS) can prove to be a revolutionary methodology for any Industry.

But the WCM model encompasses the JIT system of Management and has further revolutionised this particular aspect by introduction of the "Supply Chain Management" concept under its umbrella.

5.7 WCM AND TOTAL QUALITY MANAGEMENT

The main philosophy of TQM is prevention rather than eliminating problems after they happen. Total Quality Management is a way of doing business that creates an environment that responds quickly to client's changing requirements. In TQM, all members of an organisation need to understand their value and role, both as customers and as suppliers to every customer and supplier with whom they interact, inside and outside the organisation. Work regarding quality improvement

is continuing. TQM focuses on continuous improvement of processes in order to improve every facet of an organisation. Each process, whether it is operational, administrative, inter-departmental, or interpersonal, is continually refined and improved.

"Since the customer's needs are ever changing, TQM must necessarily embody continuous improvement. Dahlgaard et al. (1995) have called it a 'journey without an end'." (Refer book: Dahlgaard J.J., Kristensen K. and Kanji G.K (1995), *The Quality Journey: A Journey Without an End*, Productivity Press (India) Private Limited, Madras)

The basic philosophy of TQM is not wrong, but the fact is that its model is not very practical and it is not a panacea for all problems in organisations and that it fits all types of organisations. The reason being that in any organisation the resources are limited and have to be allocated and utilised after careful evaluation. It is not feasible to train everybody in everything. This may result in burning out of resources during the very early stage of the initiative. The sustainability of initiative is not there.

As far as WCM is concerned, the philosophy is that all employees are to be trained but after careful evaluation. The level of training to be imparted is different for different levels of workforce. This is done after completion of evaluation of training needs. This has proven to be very practical. All the employees will definitely be trained in the basic skills of Problem Solving but advanced training will be given to them only after proper evaluation. Further, a lot of emphasis is given to sustainability of WCM initiative.

As already discussed, the WCM approach is a very balanced one. The main focus is on Transformation of Culture without compromising on the Financials. The philosophy of WCM recognises that the Workforce is the greatest asset which an Organisation can possess and the greatest Return on Investment any Organisation can hope to achieve through investment on its Workforce. The approach is highly Employee driven.

5.8 WCM & BENCHMARKING

Benchmarking is one of the most effective means to identify improvements, which can make a significant difference to an organisation.

Benchmarking is one of the vogue subjects, along with a raft of quality related initiatives. It is not so difficult to examine- *"how other organisations have achieved improved performance"*. But examining others is a world away from really learning *"how they achieved the improvement"*.

Benchmarking though a good tool for Measuring and Monitoring of the Best Practices, but is not an initiative in itself as compared to the World Class Manufacturing approach.

The process of Benchmarking is well covered in the WCM approach also. Only just comparing with other organisations is not sufficient to bring improvement. It is very necessary to study and to be a part of the processes to gain Competitive Advantage. Nevertheless, Benchmarking is a tool, which may be very useful for those Companies striving for Business and Manufacturing Excellence.

5.9 WCM INITIATIVES AND THE APPROACH/LIMITATIONS OF ISO-SYSTEMS

ISO or International Organization for Standardisation is made up of National Standards institutes from countries large and small, industrialised and developing, in all regions of the world. ISO develops voluntary technical standards, which add value to all types of business operations. They contribute to making the development, manufacturing and supply of products and services more efficient, safer and cleaner.

Though the intent behind ISO Systems and Procedures is excellent yet it is seen that many Organisations in spite of having an ISO Certification still has a lot of loopholes and missing links in their Business Processes. As a result of which the financial results of the companies in question have been very disappointing. Many of the companies though having an ISO certification have reached on the verge of bankruptcy and still have not been able to identify the failures which led to the same. This is no reflection on ISO systems but one must evaluate "what went wrong."

WCM initiatives through their unique and generic approach have been quite successful in the identification and elimination of all loopholes and missing links in the Business Processes and the Supply Chain. The approach is an extremely balanced one and substantial results have also been achieved through the Implementation of WCM initiatives in many organisations as it is quite evident from Chapter 6.

5.10 WCM AND THE INTERNATIONAL QUALITY RATING SYSTEM™ (IQRS®)

This uses an objective audit-based protocol to measure and assess quality performance across Eighteen critical functional areas. The **IQRS®** enhances the effectiveness of all quality management systems because it is comprehensive, flexible and objective. It is a very successful system but the approach is mainly audit – based. This system does not say much about the Employees and the internal processes necessary to create 'The necessary to Build the Will". It is a system and not an initiative. It has to be coupled with other systems and procedures to make it more effective, which may lead to confusion.

WCM approach is comprised of extremely robust systems and processes. Its umbrella encompasses a majority of systems and procedures, closely integrated with each other. As already mentioned, due to its generic nature, the WCM initiative does not need to be coupled with other initiatives. The methodology of WCM implementation is very comprehensive in itself. Moreover, IQRS™ is more of a measurement and assessment system. WCM not only involves Measurement and Assessment Systems but also treats them as processes and has clear cut Methodology of Implementation. (Refer the co-relation matrixes

5.11 WCM AND THEORY OF CONSTRAINTS

The Theory of Constraints is the outcome of the practical results of Eli Goldratt's work on "how to think". It is the evolution of the thinking processes and their applications. TOC is a verifiable philosophy. By knowing how to think, one can better understand the world all around; by better understanding one can improve. Central to the concept of TOC is the acknowledgement of cause and effect. The Thinking Processes of TOC give a series of steps; which combine cause-effect with our experience and intuition to gain knowledge starting with observation of the world around us. Tools are now available to understand as to why things happen and thus we can create a better future for ourselves; with knowledge, one can improve. One extraordinary benefit of the Thinking Processes is that they provide the ability to recognize the Paradigm shifts, which occur when times change, but our assumptions and rules do not. One cannot constantly monitor every assumption to be sure one is in line with constantly evolving reality, so the ability to spot the shifts can be a real advantage.

Those who continue their patterns of operation, regardless of the changing reality, will suffer when the effects of their actions are not those that they expect.

Theory of Constraints is a new management approach in itself and is proving to be successful in many industries, however, the concept is relatively new and its applicability on a sustainable basis needs to be evaluated further. Moreover, the TOC approach seems to more towards a macro one. How far it can delve into the root causes of the problems needs further evaluation. In comparison, WCM has both the approaches well integrated into its Implementation Methodology. It first evaluates the Business in a Macro Scenario and then lays down a detailed Step by Step Approach to achieve its Objective. The TOC approach does not talk about creation of infrastructure of any sort in a detailed manner, which is may be very important to sustain the momentum generated in a structured and a systematic manner.

5.12 WCM AND SOLUTIONS PROVIDED BY SIX SIGMA

Six-Sigma is a company-wide initiative to generate breakthrough results in business performance. Six-Sigma initiatives use well-defined strategies to identify, select, and improve business performance. The tools are not new, but often many companies do use more advanced tools than those traditionally.

Six Sigma Methodology is turning out to be a very successful way of doing business but it requires substantial investment in terms of Finance and Manpower Training and a certain amount of time elapses before the results start pouring in.

In WCM the investment required is very nominal and is basically aimed at creation of in house resources. The Six Sigma Implementation Methodology is well integrated with the WCM initiative without resulting in any sort of confusion. It is an integral part of the WCM dimension – Strategic Quality Management and Best Practices.

5.13 WCM – PRESENT OPERATIONS

The most significant requirement of the changing business environment is to **remain 'aware' of the** events taking place on the concerned socio-economic scenario.

The rapid innovations in information and other technological systems call for massive investment in activities related to Research and Development. It is expected that this will not only ensure the

corporations to successfully survive in volatile competitive environment but also help them to march ahead and achieve their pre-determined goals.

It is evident that several business corporations considered to be excellent at one time either could not remain so for long or were liquidated after a short period of time. Business Corporations that are not properly aware of the impact of changes in business environment and fails to change their approaches towards utilising and managing their human and non-human resources accordingly are likely to face very critical and difficult time in the future. Thus, it will be no exaggeration to claim that business corporations will require new approaches in the new Millennium.

Some of well known contemporary approaches and initiatives in this regard are TPM (Total Productive Maintenance), TQM (Total Quality Management), Six Sigma, TOC (Theory Of Constraint), Bench Marking, ISO Systems, IQRS (International Quality Rating Systems), Value Engineering, (TPS) Toyota Production System, (BPR) Business Process Reengineering, Just In Time (JIT).

The Aditya Birla Group of India is adapting its own unified corporate strategy under the guidance of the Author for achieving manufacturing excellence and has given it a name – (WCM). The approach to achieve the status of a World Class Manufacturer as propounded by the Author is very holistic.

The WCM targets excellence in manufacturing as a mean of delighting the customers, employees and other stakeholders on a sustainable basis.

The organisational culture is one of the key factors that determine the success of a corporation. The process of formulating WCM unified strategy has undergone several exercises and various issues in this regard have been considered. The transformation of 'Corporate Culture' has been attempted for change not in one shot, rather, WCM has assured that it is not attempting to change the culture but only modifying it to give it a direction in a phased manner. It is firmly believed that appropriate adoption of WCM program will provide an opportunity for effectively facing the difficult and typical situation as already visible in Aditya Birla Group where it is being successfully implemented. The WCM program offers an opportunity to a corporation to become the champion of the champions in global market. The WCM unified corporate strategy mainly aims at generating a new profile of organisational culture. The transformation process of WCM intends to create a new organisational culture.

WCM approach aligns people towards a common goal with its unified corporate strategy. The goal is achieved by continuous, systematic and sustainable participation of self-inspired employees with team spirit and a mindset to create positive impact. In this process, employees in theform of teams attempt and try to excel in terms of **QCDIP. Excellence** and **Competitiveness** go hand in hand, and require a **Mindset** and **Culture** where **all employees** are encouraged and required to maintain **Abnormality Free Environment** and **Operating Conditions.**

WCM is an **Eight-dimensional process,** that includes- Waste (MUDA) Elimination; Work Environment (5S); Just-In-Time (JIT) & Supply Chain Management; Equipment Effectiveness (EE)/ Total Productive Maintenance (TPM); Quality First: Strategic Quality Management (SQM) and Best Practices; Customer Driven: Internal & External; Liaison, Team Force & Skill Development; Information, Systems, Technology and Cash Flows.

Employees in a world-class business **are empowered.** They have the capability of diagnosing the problem and rectifying them on their own. These employees are equipped with Tools and Techniques that enable them not only to reach the root cause of the problem but also to prevent problems before they arise. Other than the eight dimensions of WCM, the WCM program uses numbers of other tools and techniques to achieve excellence. Some of the commonly used Tools & Techniques are: Visual Management & Visual Controls, Time Management, Problem Solving Tools, Value Engineering, Single Minute Exchange of Dies (SMED), Benchmarking, One Point Lesson, Zero Abnormality Movement (ZAM), Team Force, and Multi-Skilling.

In order **to achieve zero breakdowns** and to eliminate all chronic losses affecting productivity, manpower efficiency, material and energy - certain systematic structured tools and techniques are required. The following are main Problem Solving Tools are used under World Class Manufacturing program: Why-Why Analysis, Brain Storming, Cause & Effect Analysis, PM (Phenomenon Mechanism) Analysis, FMEA (Failure Mode Effect Analysis), PDCA (Plan Do Check Act) Cycle, Flow Diagram.

Though the **ultimate aim** of WCM program is to **'Beat the Best'** and to become the benchmark for others. But before reaching at this stage one has to benchmark itself against the world class business leaders. The process of measuring the performance of a product, process or service against the highest standards available within or outside the industry irrespective of political boundaries is known as Bench Marking.

The One Point Lessons illustrate a point of basic knowledge, tips for preventing problems or any improvement topics. The idea of one point lesson is to make learning a continuous and an enjoyable experience.

The Teams are equipped with, by providing awareness on WCM followed with a certain level of understanding and Refresher Programmes. They are also equipped with Knowledge and Application of 5S, Waste Elimination, Problem Solving Tools, Autonomous Maintenance, Focussed Improvement, Upstream Management of Equipment, Customer Orientation, etc.

The Teams are provided Inspiration through Competition and Recognition by:

- Measuring the Team Performance through QCDIP
- Best model Equipment
- Best Kaizen
- Best 5 'S' Area
- Recognition through in-house Journals and
- News Letters

5.14 WHAT'S NEW IN WORLD CLASS MANUFACTURING

In the new millennium there is and will be a lot of focus on the role of creating value through good Corporate Governance **(Refer CD-1, Exhibit-5.30,** Notes on Corporate Governance) at the value adding places in the Manufacturing Units. Good Corporate Governance is the flavour of the month these days.

This millennium is the Knowledge Millennium. The main question here is how to impart this knowledge to all the Employees at the Plant level so that it may be used to increase the Shareholder's Value. This will be possible only through Focus on QCDIP. The level of QCDIP can increase only if the Operating Teams and Project Teams are imparted thorough knowledge of the Plant as well as the WCM Processes.

Invariably in many of the Manufacturing Units, either the Operating Teams or the Project Teams are more pro active. However, after detailed analysis it was inferred that unless and until both the Operating as well as the Project teams work equally till then it is nearly impossible to achieve Sustained Competitive Advantage.

World Class Manufacturing is not a labelled program. It is simply a way of managing business. It differs from contemporary programs. Some of the different aspects of WCM in the areas of Approach, Deployment, Sustainability and Assessment & Review are discussed below:

The Approach of WCM

- WCM approach is ab initio i.e. initiating from First Principles (from basics). This makes it very easy to understand, use and practice.
- Unlike large Organisations which tend to relax and feel comfortable in the company of external consultants, WCM aims to instill confidence and motivation in an Organisation's Workforce through the utilisation of any Organisation's own resources for improvement of internal processes.
- The First Launch of Two Day WCM Conference cum Workshop necessitates the participation from all the levels of Workforce including Union leaders. **(Refer CD-1, Exhibit-5.31,** Agreement with Union Leaders)
- WCM Theme Song to inspire WCM Champions and to provide a unique identity to the WCM initiative. **(Refer VCD-2(B) Exhibit-V4.4,** WCM Theme Song), **(Refer CD-1, Exhibit-5.32,** Letter head bearing the WCM Logo)
- One of the main Strengths of WCM is the flexibility of Customisation of the approach for any particular Organisation without losing its uniqueness or identity. For example translation of Study Material in local language. **(Refer CD-1, Exhibit-5.33,** WCM Study Material in Local language)
- One of the primary objectives of WCM initiative is to integrate the Business Objectives with the QCDIP Model. **(Refer CD-1, Exhibit-5.34,** QCDIP of Teams PT Elegant & Birla Cellulosic)
- Each and every aspect of WCM initiatives can be effectively co-related with day to day activities of routine life which makes the WCM Methodology easy to understand. For Example Process mapping in Six Sigma can be well explained by co relating it with the cooking process in the kitchen. **(Refer CD-1, Exhibit-5.35,** Cooking Process Example)
- WCM emphasszes a lot of focus on Restoring the Pride of the People, Rewards and Recognition and the importance of the Feel Good factor during implementation of the WCM Process in any Unit. **(Refer CD-1, Exhibit-5.36,** 5S Award Distribution Ceremony)

- The philosophy of WCM is that the Best way of Sustaining is – Any initiative is like a Theatre where every now and then some event has to happen.
- WCM philosophy believes that "the Consumer is our Boss, quality is our Work" and value for money is our Goal.
- The WCM approach emphasises that a mutual benefit is a shared benefit; a shared benefit will endure. WCM believes in utilising the resources to the full waste nothing and do only what we can do best.
- Traditional Organisations with functional hierarchies have used Trainers for specific issues but most of the WCM Facilitators are groomed for the proliferation of the WCM initiatives in house.
- The WCM Team comprises of a very young and an energetic Team
- At CWCM Cell Work and Recreation go hand in hand. The employees at CWCM Cell are encouraged to take a break from their day to day hectic work schedule and relax by playing Carpet Golf and Darts. **(Refer CD-1, Exhibit-5.37, Offiice Gallery with Golf Carpet and Dart Board)**
- Unique WCM Stationery and other items e.g. WCM Pens, WCM Notepads, WCM T – Shirts, WCM Slogans, WCM Banners, WCM Posters and WCM Badges.**(Refer CD-1, Exhibit-5.38A, WCM Badges)**
- Unique Slogans have been created to inspire and inculcate the culture **(Refer CD-1, Exhibit-5.38B, WCM Slogans)**
- The WCM Model for Competitive Advantage ensures all the Macro as well as the Micro Levels of Manufacturing and all the necessary and sufficient attention to details covering the interplay of 6 Ms (i.e. Man, Machine, Material, Methods, Money and Market) are well taken care of during the course of progress of the WCM initiative.
- The design for the WCM Model for Competitive Advantage ensures a balance focus on all that needs to be done to transform / manage the workplace for Sustainable Superior Performance for the delight of the Stakeholders.
- Unlike many other initiatives the WCM Model focuses on providing Visibility and Transparency of the Grass root level Operating Teams.
- The way of launching the WCM initiative is very unique as it aims to Transform the existing Culture and change the negative mindset of the people by creating belief in the Model.

The WCM Deployment

- Regular participation of Unit Head in WCM initiatives at Shop floor and Training Programs. culture **(Refer CD-1, Exhibit-5.39, Senior Executives' participation)**
- The Unit WCM Secretariat Heads have a direct access to the Unit Head.
- There is a regular review of Focused Improvement Projects by the Unit Head.
- The CWCM President regularly visits the Units for Periodic Reviews.
- Signature of Unit Head on WCM Monthly Status report to be sent to Corporate WCM Cell is compulsory. **(Refer CD-1, Exhibit-5.40, Monthly Status Report from a Group Unit)**
- Appreciation letter to Unit Heads from the President, CWCM Cell from time to time for their Effective Involvement and Role Model Leadership. **(Refer CD-1, Exhibit-5.41,** Sample appreciation note)
- Corporate WCM Cell has and has been conducting and facilitating a large number of Specialised Workshops at the Units and also at Regional Offices on all the Eight WCM Dimensions without any help of external faculty/facilitators/consultants. **(Refer CD-1, Exhibit-5.42,** Write up on Specialized Workshops)
- Several Units have already been successful in linking the QCDIP parameters with the Performance Appraisal of individuals and with the Business Objectives. **(Refer CD-1, Exhibit-5.34,** QCDIP of Teams PT Elegant & Birla Cellulosic)
- The Best way to impart and retain knowledge is "Learning with Fun." For Example: WCM Quiz and Games like Snakes and Ladders, Crosswords, etc. **(Refer CD-1, Exhibit-5.44,** WCM Crossword, **Exhibit-5.45,** Snakes & Ladders games, **Exhibit-5.46,** WCM Quiz,), **(Refer VCD-2(B), Exhibit-V5.5,** Live presentation at one group unit namely JayaShree Textiles)
- Some Units have developed WCM Display Gallery along the main entrance passage **(Refer CD-1, Exhibit-5.43,** WCM Gallery at Indal Muri)
- Units have developed their own WCM Web pages for proliferation of the WCM concepts, current status of the WCM activities in the Unit, etc.
- On the job training on WCM for all Operating Teams.
- Wide Deployment of WCM Activities is done through Mass Communication Meetings. For Example involvement of Students, nearby villages & townships and the Society as a whole. **(Refer CD-1, Exhibit-5.47,** WCM Wide Deployment at Birla Cellulosic)

- Some Units have adopted the nearby Townships and Railway Stations for the purpose of taking them to World Class Levels.
- The WCM mechanism of deep deployment ensures perfect synergy between Training and Consultancy. This results in all isolated positive effects amalgamating in complete harmony with each other resulting in significant improvement in the Organisation's Bottom line.

Sustaining the Momentum

Some of the unique ways to Sustain the Momentum of WCM Activities like:

- Annual Review Meeting of the Unit WCM Secretariat Heads
- Chairman's Awards for Manufacturing Excellence.
- Score card – This is a measure of a Unit's Progress on WCM Activities. **(Refer CD-1, Exhibit-5.48, Sample Summery Monthly Score card)**
- Periodic Newsletters – Sharing Best Practices and Creating Intellectual Capital. **(Refer CD-1, Exhibit-5.49, Sample of Award Newsletter)**
- Quarterly Self Assessments by the Units. **(Refer CD-1, Exhibit-5.50, Quarterly Self Assessment Report)**
- Key Performance Indicators for overall Summary of Progress on WCM Activities in a Unit mainly on a Quantitative basis. **(Refer CD-1, Exhibit-5.51, Sample WCM Indicators)**
- Monthly Status Reports. **(Refer CD-1, Exhibit-5.40, Monthly Status Report)**
- Proliferation of Best Practices as and when required
- Refresher Programs
- Utilization of Cable TV Network for proliferation of WCM messages.
- WCM Campaigns and Slogans. **(Refer CD-1, Exhibit-5.38B, WCM Slogans)**
- Organizing Poster and Slogan Competitions. **(Refer CD-1, Exhibit-5.52, Slogan Competition)**
- Conducting of 5S at Home Competition.
- Celebration of WCM Day / Week every Six Months. **(Refer CD-1, Exhibit-5.53, WCM day Competitions)**

5.15 THE CO-RELATION MATRIXS OF WEM EXCELLENCE AWARD WITH OTHER AWARDS

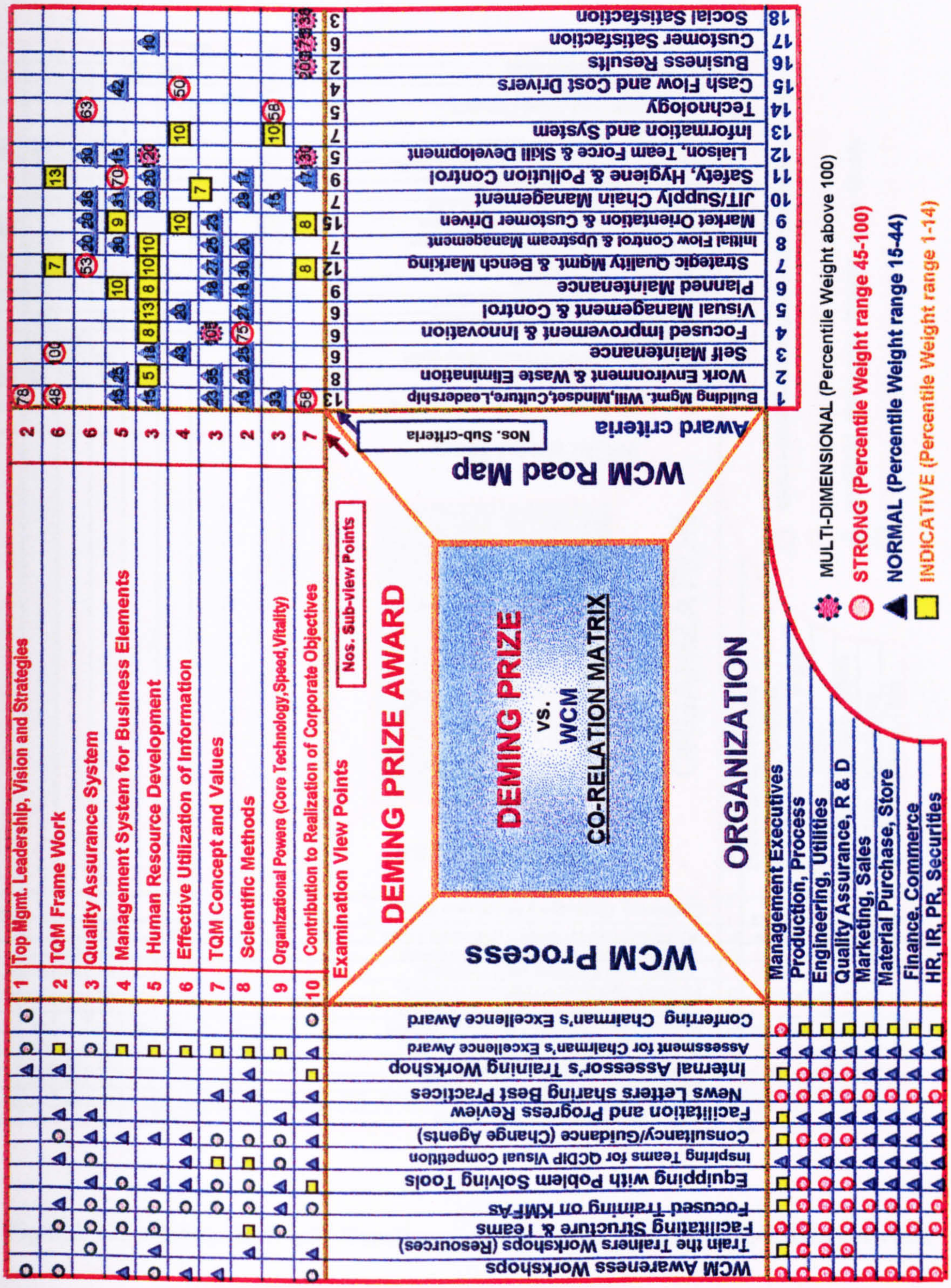


Fig 5.1: Co-relation of WCM Excellence Award with Deming Prize Award

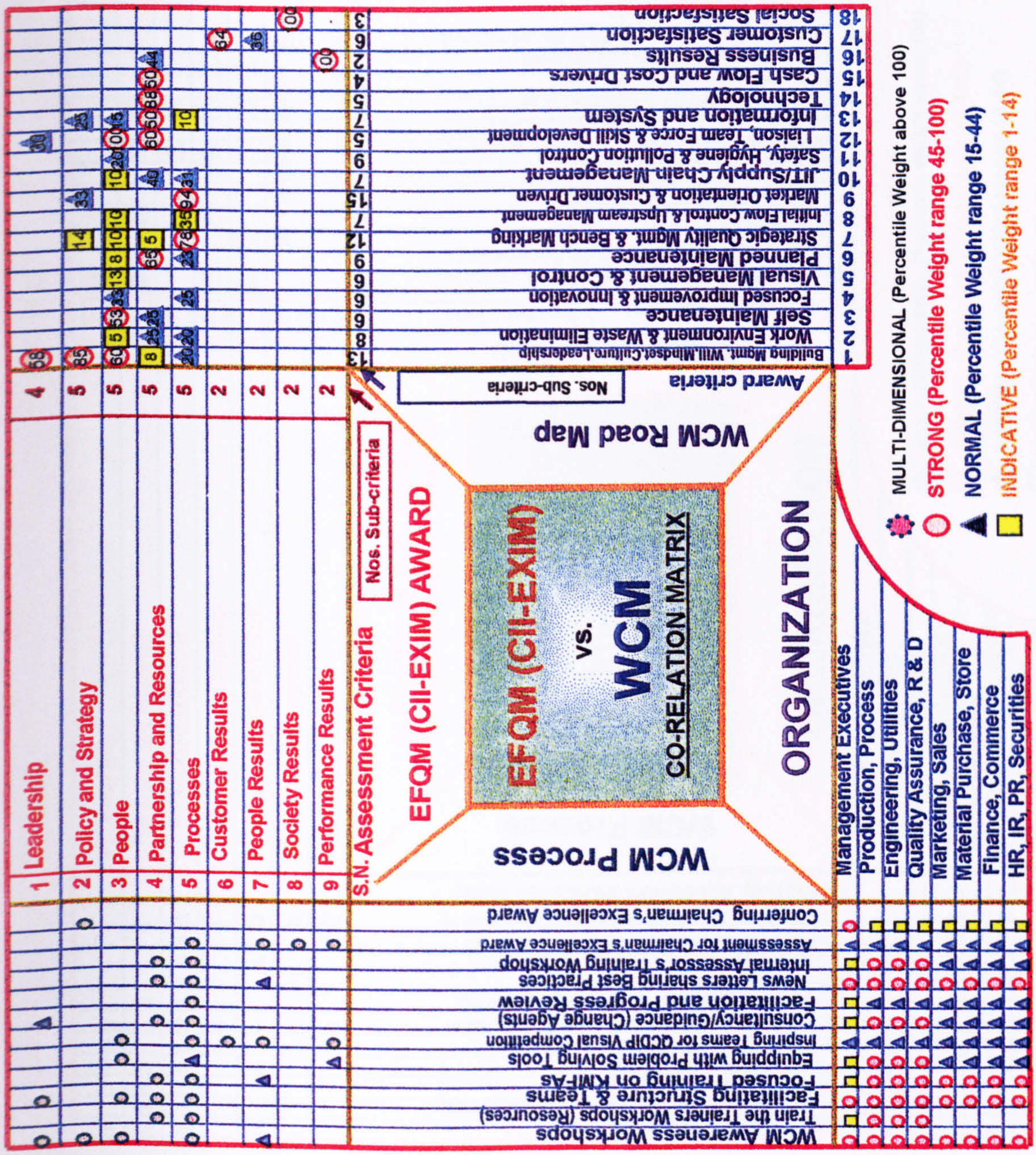


Fig 5.2: Co-relation of WCM Excellence Award with EFQM (CII-EXIM) Award

Fig 5.3: Co-relation of WCM Excellence Award with MALCOLM BALDRIGE Award [220]

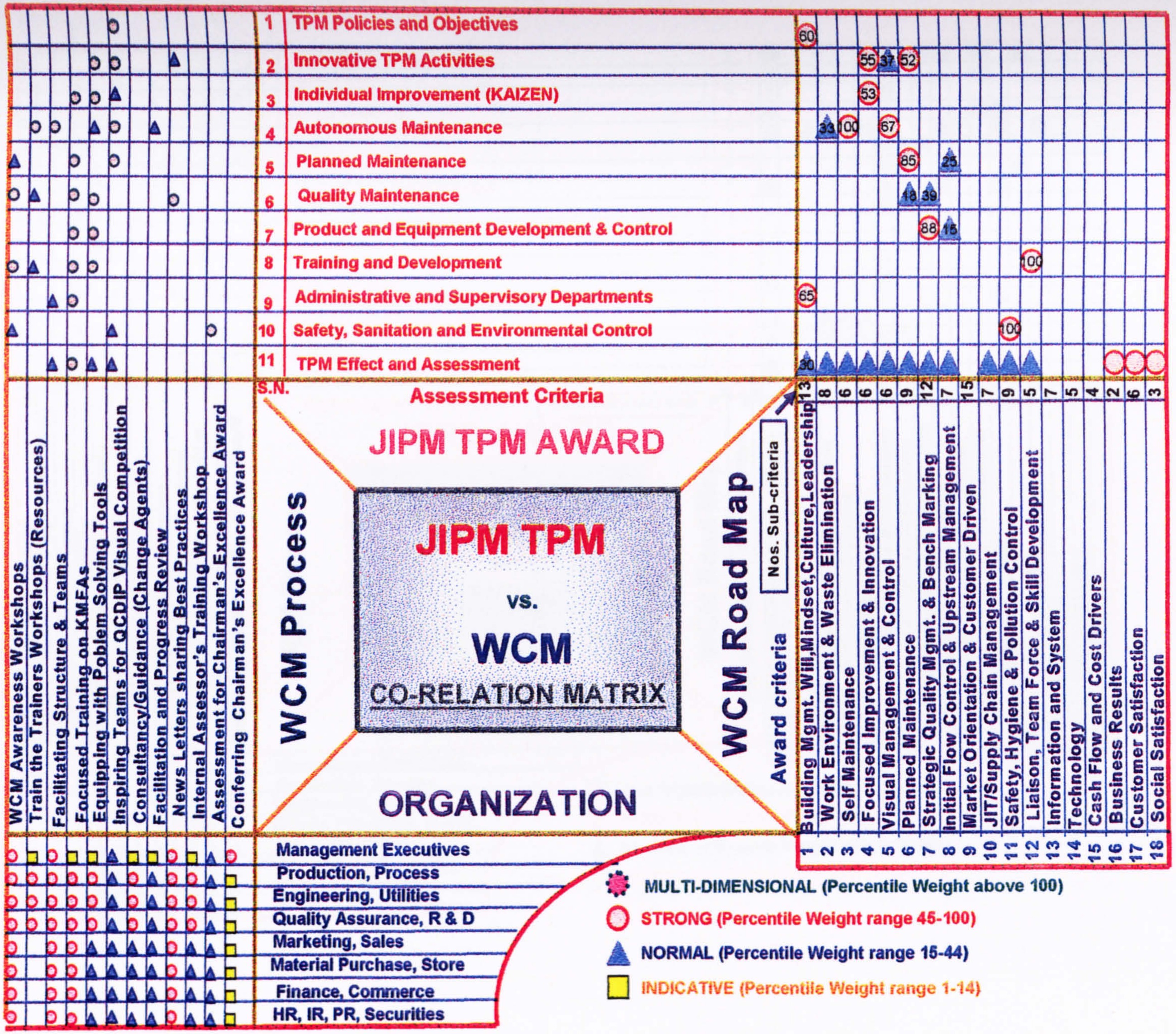


Fig 5.4: Co-relation of WCM Excellence Award with JIPM TPM Award

[221]

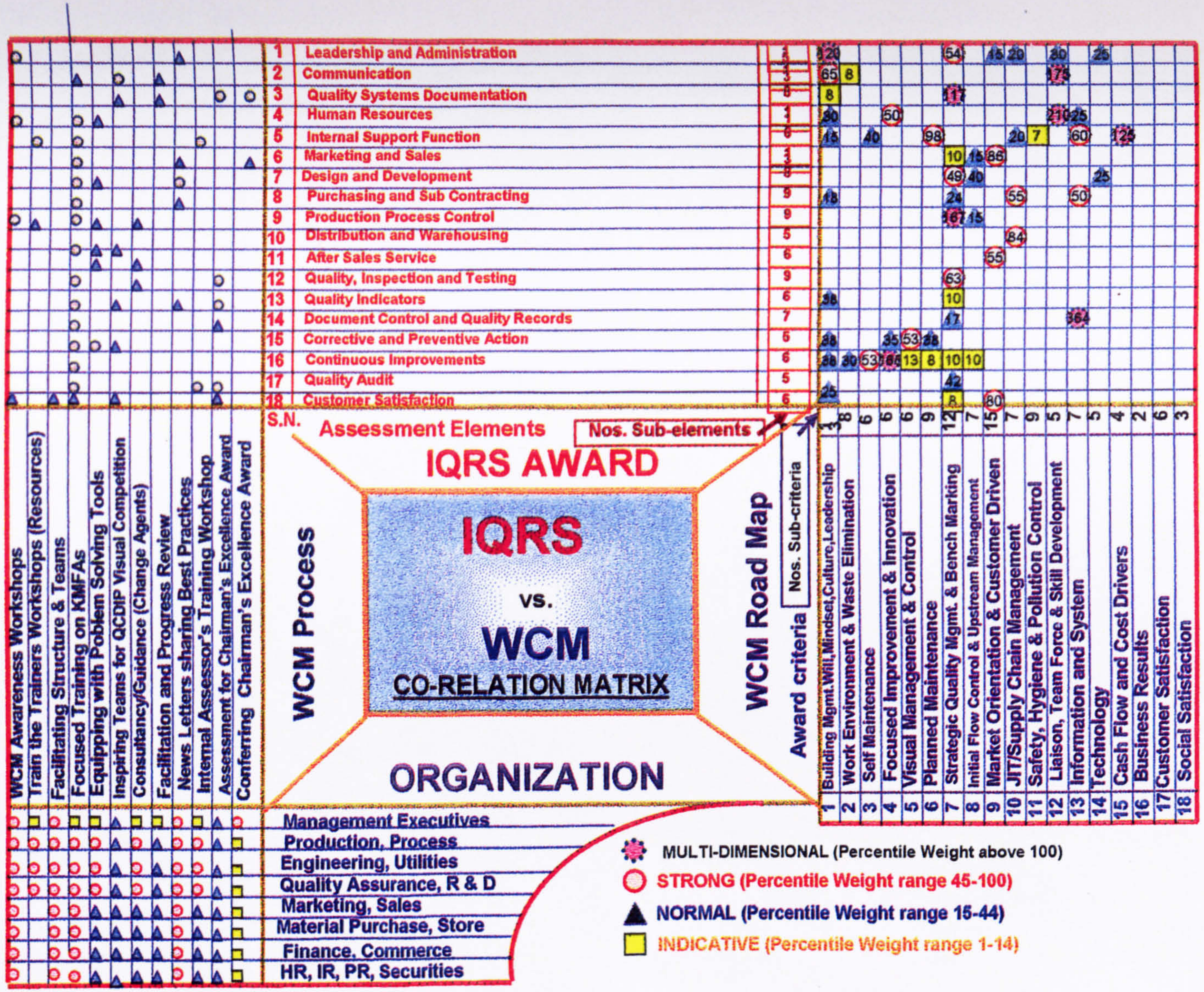


Fig 5.5: Co-relation of WCM Excellence Award with IQRS Award

[222]

5.16 THE IMPLEMENTATION OF WCM IN INDIA – A FEW IMPORTANT LESSONS

Though many of these stories reflect as Case Studies in Chapter 5 yet there were some very important lessons which were learnt during the WCM implementation process in India. Some of these also refer as a part of the case studies in Chapter 5, yet these have been summarised again in this chapter to reiterate their importance.

Learning from:

The case of a Chemical Industry which is into the manufacture of chemicals. It had already won the prestigious Japanese JIPM-TPM Award when it was decided to implement the author's WCM.

The Problem Issues

One of the main issues that this company was facing was that in spite of having won the TPM Award it was not able to focus on other business related issues including managing of inventories, efficiencies of the supply chain, efficient information systems. Therefore, a need arose to follow an approach which would not only sustain its already very strong equipment management systems but also lead to the maximizing the efficiencies of the other business processes which would subsequently help in bridging the gaps between excellence and baseline.

The Failures faced:

In the initial stages, WCM received a big setback with both the Top Management and the workforce unwilling to adopt the approach. The reason being that the organization was already pursuing TPM. A number of Quality Systems were in place. The organization was worried that it would lead to a confusion with so many initiatives running in parallel.

Successes achieved:

The greatest achievements came in the form that the organization went on to win the Silver Award launched by the Group of Companies. This particular organization in developing an overall business perspective the essence of any business.

Lessons learnt

The main lesson learnt here was that it is possible to integrate any other initiative with comprehensive, total and a complete approach like WCM and without creation of any confusion. The facilitating framework of any improvement initiative should be so designed (e.g. WCM) that the implementation is in a definite and a structured manner yet it is open-ended to allow for flexibility, creativity and easy integration. With so many new improvement initiatives in the world today it is necessary to have an initiative that is sustainable and has the characteristics to encompass the strengths of any other initiative with losing its own uniqueness.

(The name of the above- referred company has deliberately been omitted for the necessary reasons).

5.17 FUTURE INTENTIONS – THE WAY FORWARD

World Class Manufacturing initiatives may not be limited to the field of manufacturing only. The concepts of JIT and Supply Chain Management have been very successfully applied in the fields of pharmaceuticals, financial services, catering industry, restaurant chains. Strategic. Quality Management features as a very important part in the development of defect free software in the field of information technology.

The Eight Dimensions and their implementation Methodology are poised to be applied in the field of Marketing, Service Industry such as Hospitals and Healthcare. Since the hospital industry is highly customer centred, therefore most of the concepts of quality management are extremely applicable to this industry. For example, the concepts of process control in a hospital industry refer to the in-patient and out-patient care and related activities, which are carried out under controlled conditions, thereby ensuring that the patient receives the best possible service. The applicability of WCM in the field of Insurance and insurance related products are strongly being considered. A lot of groundwork has already been done to apply the author's WCM in the field of Defence and Telecommunications.

CHAPTER-6

WCM: IMPLIMENTATION ROAD MAP

The Implementation of WCM Model, which is an unique and holistic initiative can result in significant benefits such as increased competitiveness, reduced costs, better quality.

The detailed Roadmap, is being produced below:-

6.1: Introduction to Road Map

The process involves a cultural transformation leading to **Organizational Change**, better **Management Processes** and **Organization Learning**. It focuses on people, process and results on a continuous basis. WCM is in itself, a competitive strategy that aims for stakeholders, including customers and employees delight through focus on sustainable and superior QCDIP (Quality, Cost, Delivery, Innovation, Productivity & Pride) performance and other Parameters. WCM helps in achieving this Sustainable, Superior Performance by putting in place the "Art of Manufacturing for Consistent Excellence".

Group Vision

To establish ourselves as the First Choice of the Stakeholders including Customers and Employees in this borderless World

Group Mission

To raise the standards of our QCDIP Performance to World Class Levels

The Road Map covers the journey for excellence right from **Team Structuring** to **Continuous Transformation** in all the Eight Dimensions of WCM. The Criteria are applicable to all the units irrespective of the nature of the products and processes. The analysis for measuring excellence would be both quantitative as well as qualitative.

6.2: The Frame Work

The following flow chart explains the framework that consists of Enablers, Processes and Results.

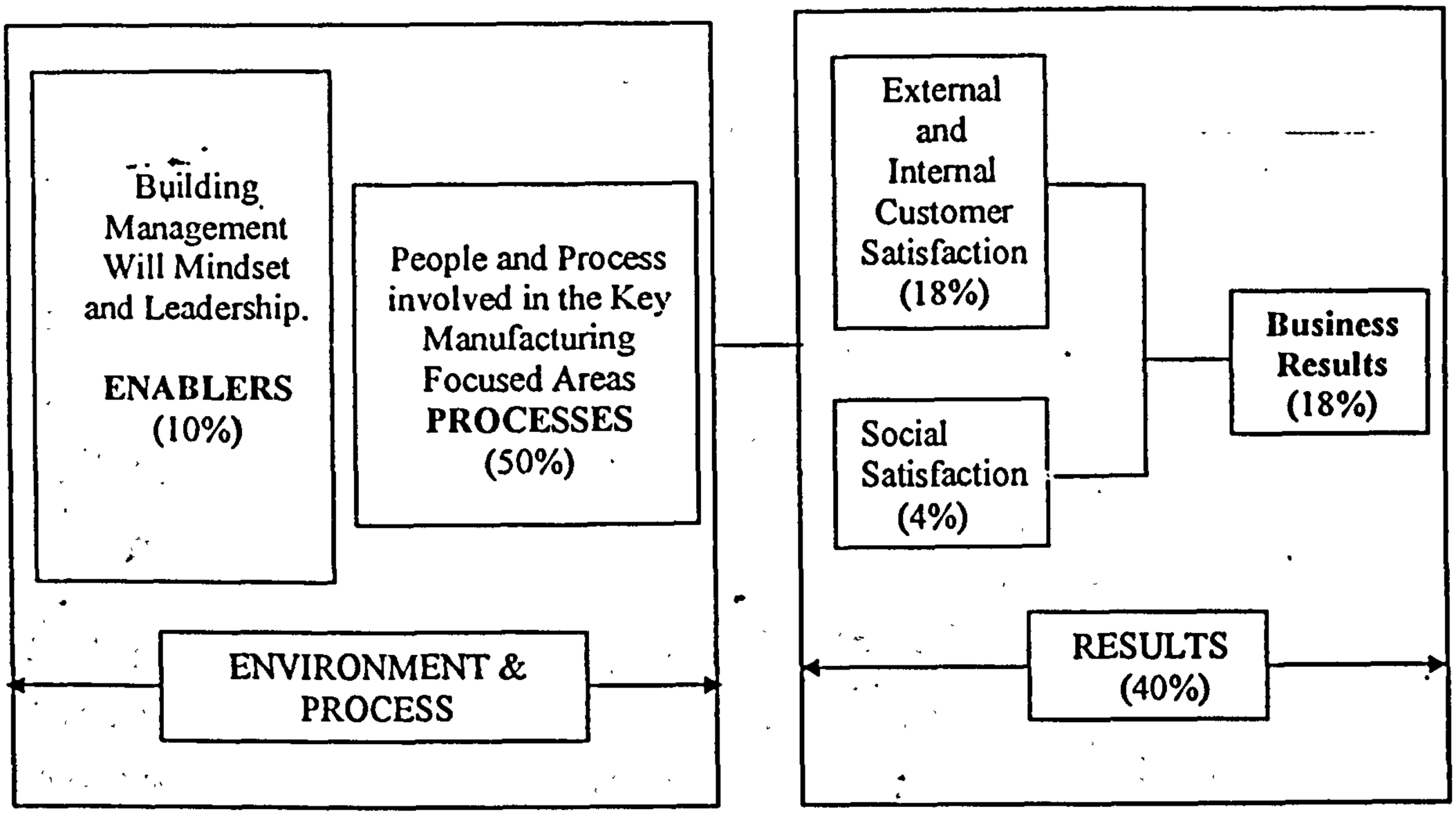


Fig 6.1: The Frame Work

The Enablers promote exceptional Performance from the people and the Processes. The enablers perform the following functions:

1. Establish Vision, Mission, Policies and Strategies
2. Facilitate an environment conducive to learning and innovation
3. Stimulate breakthrough improvements
4. Inspire superior all round sustainable performance

The Enablers that inspires superior performances are driven through the following Processes Criteria

1. Building Management Will, Mind set, Culture and Leadership
2. Work Environments and Waste Elimination
3. Self Maintenance

4. Focused Improvement and Innovation

5. Visual Management including Visual Controls

6. Planned Maintenance

7. Strategic Quality Management and Benchmarking

8. Initial Flow Control / Upstream Management

9. Market Orientation and Customer Driven

10. JIT/ Supply Chain Management

11. Safety, Hygiene and Pollution Control

12. Liaison, Team Force and Skills Development

13. Information and Systems

14. Technology

15. Cash Flow and Cost drivers.

The Improvement **Process and the Results** are to be documented at all stages from day one throughout the Journey of the Unit to Manufacturing Excellence. Such documentation shall include score cards, charts, photographs/ video films covering the status before and after the improvement, campaigns etc. used to put in place the new culture, the Culture of Prevention, Productivity, Quality & Innovations. The documentation shall form a basis for tracking the growth rate and management reviews. The basic rule is that what is done should be documented; what is documented must be understood; what is understood must be managed and what is managed must be improved. The benefits derived there from must be calculated and documented. This completes the cycle.

The Units Results shall be expressed in relation to the:

a. Past performance/ Trends.

b. Comparisons with own targets. .

c. Comparisons with "Best in Class" performance.

The Results Criteria includes the following:

a. Business Performance (QCDIP and Financial)

b. Customer Satisfaction (External & Internal)

c. Impact on the Community / Society

6.3: Benefit of the Assessment Process:

Assessment and Improvement drives business results

There is a direct correlation between Award winning companies and their business performance. This has been proved in the case of Malcolm Baldrige Award winning companies through Stock Performance studies by the NIST (National Institute of Standards and Technology - USA). The Assessment sharpens the focus of the Organization towards continuous improvement and innovation.

Practice of Self-Assessment

The concept of Self-Assessment is being proliferated through the Award and detailed guidelines have been provided to facilitate the self-assessment.

Recognition drives participation

An effective way of providing motivation for the Units is to sponsor a recognition process. The recognition process by itself inspires further achievements on a sustainable basis.

Assessment is linked to Group Vision

Assessment is a part of the business evaluation and improvement cycle. One of the best ways to ensure that assessment results are linked to the business and are used to drive improvement is to engage the management team in the assessment process.

Senior Management involvement

The process of assessment necessitates involvement of Top/ Senior Management personnel and this helps in enhancing their sense of ownership with the movement.

Accelerates learning

The common benefit of participating in a self-assessment or recognition process is the

organisational learning. The degree of learning is directly related to the amount of work the organization puts into the process. Reducing the time and money spent in the assessment process reduces the learning. Learning by doing is an essentia! component of Award Assessment. The process of assessment brings in clarity and understanding of the concepts and application

Evolving and Improvement of Criteria

From time to time, the criteria are modified and improvements are brought in. Emphasis can change on specific areas and accordingly weightage can undergo a change. The Award Structure itself goes through a process of change keeping in tune with the changing environment and scale of achievements.

General guidelines

1. The Site visit by the Assessment Team is very important in the Assessment. While the primary responsibility is with the Assessment Team, considerable support is required from the Unit to make the assessment thorough.
2. The Unit should ensure availability of all Essential personnel during the Site visit for effective sharing of information.
3. All the necessary documentation should be kept handy and made available to the Assessment team immediately. It should be noted that in the absence of proper documentation the process of Assessment would be highly handicapped. The basic rule is that what is done should be documented; what is documented is well understood; what is understood can be easily managed and what is managed can be improved. Given below are a few examples of documentation for reference.

- 'Before' and 'After' Photographs
- Minutes/Agenda of meetings/Meeting schedules
- Policy
- Manuals
- Checklists
- Compliance records
- Case studies
- Skill charts
- Training calendar

- Training calendar
- Training feed back forms/summary
- Write up of procedures
- News letters/House Magazines
- Customer complaints
- Correspondences
- Survey reports/summary
- Certificates
- Action Plans
- Trend reports of various process and result parameters.
- Employee Appraisal/Career Progression plans
- Performance reports
- Process Mapping

1. It is very important to note that as far as Result criteria are concerned it is absolutely essential that a measurement system be well in place. The onus of providing the result measures lies entirely with the Unit being assessed. For those Units where Financial Results are not directly available it is necessary that the Unit arranges for the information from the group level or should provide an equivalent plant measure.
2. The progress and achievements should bring out the Unit's journey towards excellence through WCM initiatives. The Presentation should be brief and the purpose is to give an overall birds eye view and is not expected to be a substitute for the Site visit and discussions. The Assessment Team will in turn make a presentation, which would cover, scope and objectives of the Pre Assessment, brief outline of the methodology, time schedule, and other arrangements required for the smooth conduct of the assessment process.

6.4 Award Process

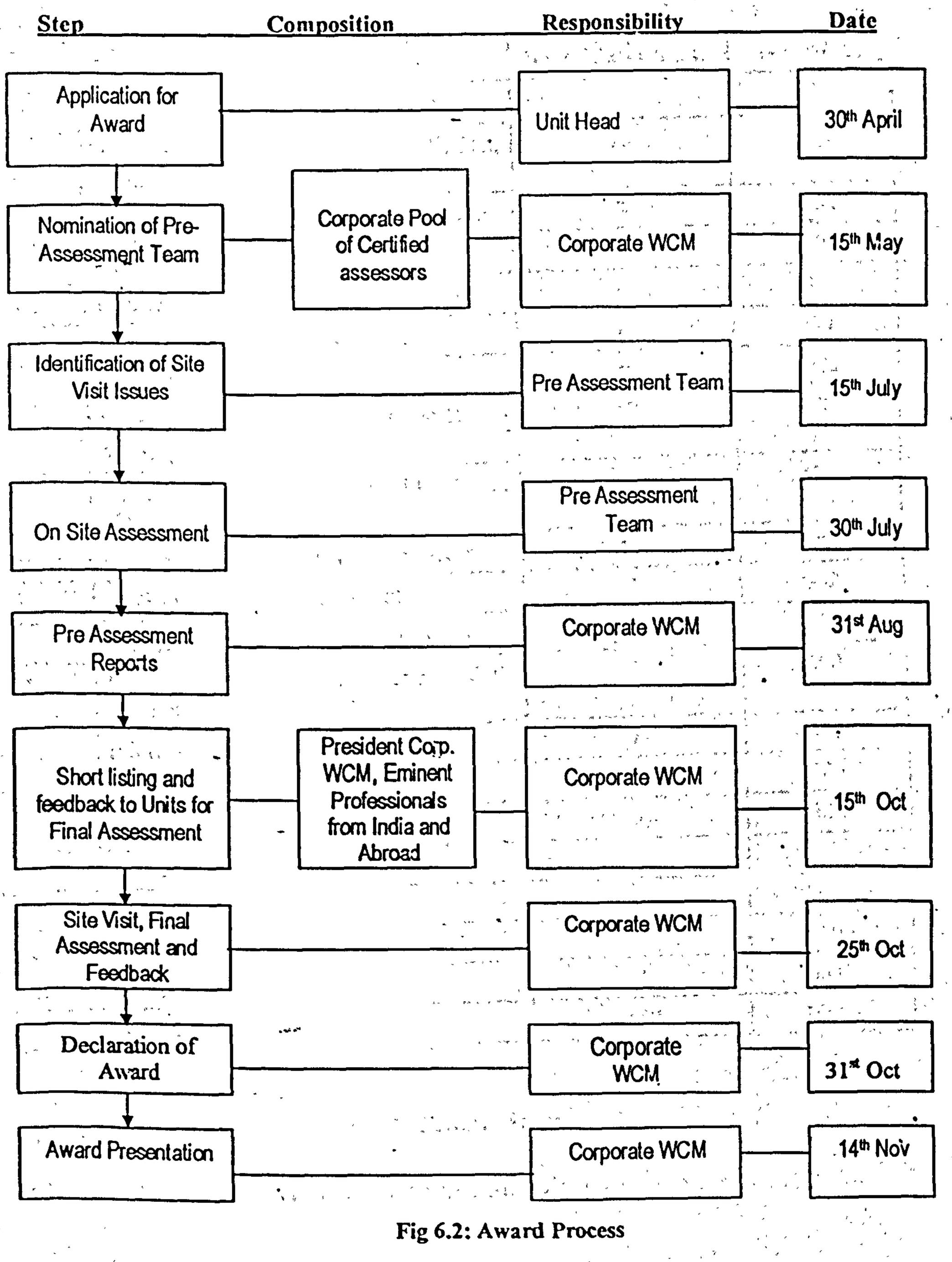


Fig 6.2: Award Process

6.5 Criteria Summery

S. No	CRITERIA	No. of Sub criteria	Weightage
	ENABLERS and PROCESSES		
1.	Building Management Will, Mindset, Culture and Leadership	13	2000
2.	Work Environment & Waste Elimination	8	1000
3.	Self Maintenance	6	1000
4.	Focused Improvement and Innovation	6	1000
5.	Visual Management and Control	6	750
6.	Planned Maintenance	9	1000
7.	Strategic Quality Management and Bench Marking	12	1000
8.	Initial Flow Control/Upstream Management	7	500
9.	Market Orientation & Customer driven	15	1000
10.	JIT/Supply Chain Management	7	500
11.	Safety, Hygiene and Pollution Control	9	750
12.	Liaison, Team Force and Skills Development	5	500
13.	Information and Systems	7	500
14.	Technology	5	200
15.	Cash Flow and Cost Drivers	5	300
	RESULTS		
16.	Business Results	2	3600
17.	Customer Satisfaction	6	3600
18.	Social Satisfaction	3	800
19.	**Grand Total**	**130**	**20000**

Table 6.1: Criteria Summary

(Refer CD-1, Exhibit-6.54, WCM Award Criteria/Sub-criteria)

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GLOSSARY OF TERMS

Abnormality Management: The creation of an organisational culture where every kind of abnormality is immediately noticed, rejected and removed. To begin with through a structured approach employees are trained to identify and record abnormalities which in normal course go unnoticed or even accepted as normal.

Affinity Diagram: The affinity diagram is a structured method of brain storming that can be used for larger complex activities such as developing a Mission statement or Vision statement. The large issue needs to be broken into smaller issues. Thus an affinity diagram helps break down a complicated issue into an easy to understand smaller issues.

Appraisal cost: Appraisal means the activities involved in the inspection of the output to detect non-conformance and auditing conformance. The costs involved in these activities are termed as appraisal cost. This should include the cost of manpower, space, materials and other facilities used.

AQL: An abbreviation for Acceptable Quality Level, a terminology used in sampling systems. AQL is usually defined as the maximum permissible defective (or the maximum number of defects per hundred units) that for sampling inspection can be considered satisfactory as a process average.

Autonomation: Please see under 'JIDOKA'

Bench Marking: In essence Bench marking is moving from "Where you are to where you want to be". A benchmark is a point of reference against which things are measured. In business these points of reference or standards can take many forms. They are measured by questions about the products or service (e.g., how many, how much time, how much money, how reliable, or how well made is it?)

Worldclass: Compare with the world recognised leader in the process that is to be compared.

Brain Storming: A group exercise to generate, clarify and evaluate a large number of ideas, problems and issues. However during the idea generation phase no evaluation is to be done and free flowing ideas have to be stimulated.

BPR: Business Process Re-engineering.: This is like starting from scratch with a conceptual change leading to improved customer service and satisfaction. Some of the principles of re-engineering are given below:

a) Organise around outcomes, not tasks. Design the job of a person around an outcome instead of mere task.

b) Subsume information processing work into the real work that produces the information.

c) Treat geographically dispersed resources as though they were centralised.

d) Link parallel activities instead of integrating their results.

e) Put the decision point where the work is performed and build control into the process.

Capture information once and at the source.

CAMMS: Computer aided maintenance management system, an integrated computer package which facilitates information needs for planning, organising and controlling and improving the maintenance performance through improved availability and reliability at lower costs.

Career paths : A road map pertaining to an individual in an organisation indicating the possible progression in his career within the organisation. In addition to the individual's potential, development through job rotation, training inputs form the basis for the planning of the career path.

Cause and Effect Diagram (Analysis): This method is used to analyse the various factors affecting the situation and to identify root cause for the problem. This is also known as fish bone diagram because of the shape of the diagram. The process is seen in its elements such as people, machinery, procedures, policy etc.

Check Sheet: It is a form on which data may be collected systematically and recorded in a uniform manner. The tool can give the team a clear and objective picture of the facts, if the categories are complete and include the source.

Chronic Problems: This term refers to those problems, which occur very frequently and almost continuously. In statistical terms these are called natural variation within process caused by large number of small causes that occur simultaneously and are referred as chronic.

Cross-functional: Indicates the formation of a team which consists of members from different disciplines /functions. The cross-functional nature of the team enables them in analysing the causes of complex problems, which falls across several functions.

Cp Value: A measure of the process capability in statistical process control (SPC).

SPC is a tool to measure the variability of a process and determine its capability to produce a particular product. A measure of the variation in the process with respect to the acceptance tolerance limits for an item is referred as Cp.

The larger the Cp the better is the process capability.

Cpk Value: This is a measure of a process and its effectiveness in delivering products to required quality specifications. Cpk is calculated as given below:

Higher the Cpk value, the less is the variation inherent in the process or the larger the specification limits.

Control Chart: A control chart is a special type of trend chart with limits specially used to assess and maintain the stability of the process. This indicates whether the process variation is natural and to be expected (chance variation) or due to special causes. The upper control limits (UCL) and lower control limits (LCL) are calculated from the standard deviation. It helps to objectively determine if a process is 'In control' or 'Out of control'

Cost of Conformance (COC): The intrinsic cost of providing products or services to declared standards by a given specified process in a fully effective manner.

Cost of Non Conformance (CONC): The cost of wasted time, materials and capacity associated with a process in the receipt production, dispatch and correction of unsatisfactory goods and services.

CSF: An abbreviation for Critical Success factors, which are single focus statements in the form of a sentence that lead to the achievement of the VISION.

e.g. "Our top ten customers have granted as the preferred supplier status"

Current Ratio: The ratio, which reflects the liquidity of an organisation. The ratio is arrived at by dividing the current assets (inventories, receivable, cash and bank balance, Marketable securities, loans and advances, pre-paid expenses etc.) by Current liabilities (Accounts payable, interest and loans re-payable, accrued expenses and provisions etc.) A ratio of 2 and above indicates good liquidity position.

Customer Driven Quality: The quality parameters evolved based on the needs of the customer. The customer requirements are translated into product specifications; which are in turn converted to manufacturing/process specifications

Customer Driven Organisation: An organization where the guiding spirit is satisfying the customer needs.

Customer Satisfaction: It means not only satisfying the needs and reasonable expectations of the customers but also adapting an attitude that puts his needs first.

Customer Service Time : The customer service time is concerned with the entire process from (i) the customer placing the order through (2) manufacture to (3)the dispatch of the products. The difference between the order receiving date and the order dispatch date is the Customer service time.

Customer Survey : A survey should consider the following:

Product performance

Product delivery consistency and status advice

Product safety and handling

Response for complaints

Technical problem solving and tools of quality

Order handling efficiency

Quality /knowledge of technical staff

Quality/Knowledge of commercial & Logistics staff

Value for money

Product improvement ability

Responsiveness and sensitivity of the whole company

CWQC: An abbreviation for Company Wide Quality Control. A system where the meaning of Quality is total and with involvement of all employees continuous improvements are engineered. Customer is the focus of all activities

DPA: Abbreviation for Department Purpose Analysis., the purpose of which is to review the internal customer - supplier relationship. This approach involves (a) Identification of the role of the department (b) Getting the approval for the role identified (c) Identifying for whom the function is being performed (d) Check if the function is being performed the way the customer wants it. (e) Find what objective the function has, on the primary objective of satisfying the requirements of the external customer.

D:P Ratio: Here D stands for delivery lead time and P stands for production lead time. This ratio links customer requirements with the manufacturing process. The production lead time is the time taken to purchase the raw materials and to manufacture the product from scratch. The delivery lead time is the lead time offered to the customers If the value of D is greater than P the product can be made to order. If the value of D is less than P the product must be made to stock.

EOQ/EBQ: An abbreviation for Economic Order Quantity/Economic Batch Quantity. It is the order lot size at which the ordering cost and inventory carrying costs are optimised. The concept of optimising between set up/changeover cost with the inventory carrying cost also was used in arriving at economic batch quantities .The concept of EOQ/EBQ is now being challenged with the introduction of JIT where the set up times are themselves are challenged and drastically reduced to enable economic processing of much smaller batches going towards Single Product Flow.

External Customer. The customer who utilises our product; "service" is our external customer. In the absence of a specific mention the word customer often refers to external customer.

ERP: Enterprise Resource Planning covering all the resources.

External Failure Costs: The costs arising after delivery to a customer /user due to non-conformance or defects which may include the costs of claims against warranty, replacement and consequential losses and penalties.

Failure Ranking: Ranking given to the failures based on their criticality and impact on the process.

Fault Tree Analysis: The illustrated connection between a non desired occurrence at a higher level and the cause of this occurrence at a lower level.

FMEA: An abbreviation for Failure Mode and Effect Analysis. This is a proven tool for fool proofing of a design or process. FMEA involves structured thinking through the likelihood seriousness and probability of detection of potential problems. Through brain storming identify potential problems and estimate likelihood of it going wrong on a 10-point scale. Also estimate how much it is likely to cost for each potential problem again on a 10-point scale. For each potential failure estimate on a 10 point scale how probable is the occurrence. By multiplying the individual ratings arrive at RPN (Risk priority number). RPN=Occurance*Severity*Risk

FMEA gives a structured way of assessing possible failures and which areas to investigate first. A major advantage is that it does this at an early stage in both products and processes.

Areas with high RPN are chosen for examination and actions to prevent.

Group Think: Group Think is said to have occurred when dynamics in the group makes the group strive for agreement on issues rather quickly without critically processing the PROS and CONS. Group Think happens when the group is cohesive, members have strong positive feeling and high motivation for being part of the team and the leader has strong views.

Histogram: Histogram is a frequency distribution diagram, a graph that displays distribution of data. It communicates information about variation in a process.

House Keeping: A terminology encompassing all those activities that are necessary for Cleanliness, orderliness, and neatness in all areas of work and seen as an inherent part of every employee's job now a days. House keeping has been very successfully practiced across the organisation through the proven 5 S principle.

Initial Flow Control: Initial flow control deals with shortening of the lead time between product development and production and very effective investments in equipment and the operating system .The initial flow control involves utmost care at the design stage itself , namely design/selection of equipment, layouts, product flow etc. to achieve the following:

Optimising life cycle cost

Maintenance prevention design

Production systems with quick start up.

improve overall equipment effectiveness.

Improved visual management

Easy maintainability/ Operation & autonomous maintenance.

Defect free production

Internal Customer: This term refers to all those who receive one's output from within the organisation. The internal customers can be departments within an organisation or individuals who can be peers, or even have superior/subordinate relationship. The next step in the process is an internal customer.

Internal Warranty System: A system of warranty applied to internal customers. For example the maintenance department treats receivers of its service such as production as customers and gives warranty on its service. The difference is the legalities involved in the warranty system with

the external customers are absent .The internal warranty system enhances internal customer satisfaction.

Internal Failure Costs: The costs arising within an organisation due to non conformities or defects at any stage of the quality loop and which may include costs of scrap, rework, retest, re inspection and re design.

IT: Information Technology: The study of information needs across the organisation and the system installed to gather, process and deliver information for operational and business decisions. IT has become an integral part of business operation.

JIDOKA: This is a Japanese word which indicates automation with a human mind also known as autonomation. Although autonomation involves some automation, it is not limited to machine process. It can be used in conjunction with manual operation as well. It is predominantly a technique for detecting and correcting production defects and always incorporates a mechanism to stop the line or machine when abnormalities or defects occur.

Jishu Hozen: A Japanese word for autonomous maintenance where the basic maintenance activities such as cleaning, lubrication and minor adjustments/repairs are carried out by those operating the machines. The machine operators are trained in the features of the machine and its maintenance.

JIT: A Management approach where zero inventory is the approach. The system involves Producing only what is required and is applicable through out the manufacturing process and extends to purchase also. Components and parts are delivered just in time directly to the point of use cutting down several non value adding activities in the process. Internally parts are produced only on demand from the next stage in the process, which is tailored through a proper work method. JIT culture necessitates very low lead time of process and purchase, very quick change over times in the production process and very low batch quantities leading to single product flow. JIT in summary means a highly efficient and high performing organisation with excellent ability to respond to changing needs.

Kaizen: A Japanese word for continuous improvement by every one in their day to day work. Basically KAIZEN culture means every employee is committed to continuous improvement.

Kanban (or Kamban): A system of production management under the JIT system. Kanban is a Japanese word for Card. The cards individually made for each component/part signals the need and initiates action to produce only the specific quantity mentioned in the card. Kanban is a Japanese word meaning 'display' or 'instruction card'

The kanban system has two functions: One is "Production control" and the other is "Process Improvement".

Key Business Process (KBP) : A key Business process(es) is (are) that which an organisation has to excel in order to achieve competitive edge. KBP normally cuts across functions.

Examples of key business process; Product/service development, engineering/process

Kiken Yochi Training (KYT): A Japanese word for training on Dangerous occurrences. Employees are trained on counter measures in the event of a dangerous occurrence such as fire, explosion, gas leakage etc. so that the danger is controlled immediately, and protective measures to save lives, property and damage to environment are taken quickly.

change etc.

LCC: Stands for "Life cycle costing " which simply means the total costs (Direct, Indirect, recurring, non recurring and other related costs) incurred during the whole life of a product or system Basically it includes the cost of owning, cost of usage and the cost of final disposal of a given equipment/facility.

LCL: Lower Control Limit. Indicates the line in a control chart, which marks the level, three times the standard deviation below the mean. Any observation below the lower control limit indicates the presence of a special (sporadic) cause which has to be immediately identified and removed.

Lead Time: The time required to satisfy a customer order, starting from the point when the order is received and ending at the point when the customer receives delivery.

Least Man: The concept of Least man was applied in Toyota to reduce the total number of people employed to make products. The approach essentially involves multi machine operation facilitated by autonomation to reduce dependency on workmen.

Logistics: Logistics involves all those management functions dealing with physical storage/flow of material/goods and services from the point of raw material acquisition to the point of final consumption and the associated information flow necessary to set these things in motion.. The objective of Logistics is to make available products and services to the customers at the time, place and in the form desired. Transportation, Storage and Order-Handling are the three principal activities of logistics,

Market Research: Market research involves study of the market present, past and future. Also includes research into the effectiveness of different elements in the marketing operation such as sales, advertising and distribution. The main categories of market research are:

- Collection of facts.
- Assembly of people's opinion, attitudes, views about products events or companies.
- Testing marketing operations (Test Marketing, Product screening, Sales methods/Tactics, advertising operations etc.)

MBWA: Management By Walking Around. An approach where managers interact and observe problems by physically moving round the plant rather than relying on analysis and reports.

MIS: Management Information Systems: Deals with collection, storage and presentation of the right information at the right time to manage for effective and timely decision making. The MIS also focuses on control information for timely detection and correction of deviations. The design of MIS starts with identification of information and needs of individuals

Mission : The mission of an organisation is expressed through a MISSION statement, which says what business the organisation is engaged in, and the competitive advantage required over others.

An example of a Mission statement is given below:

"To market health care products that have a demonstrable health benefit to the customer to be a leader in each product line, to return a fair profit to our stock holders and to provide good opportunities to our employees".

Another example of a MISSION statement: Our Mission is to identify opportunities to reduce patient waiting time in outpatient areas so that:

All patients are seen within 30 Minutes of their scheduled appointment time.

Patient satisfaction is measured and improved.

Provided satisfaction is measured and improved.

Medical records availability and accuracy are at 100%.

MP Design: Means maintenance prevention design. In this approach, attempts are made at the design stage of an equipment to eliminate or at least minimise the need for maintenance. This would result in reliable equipment that will ensure stable performance through its life cycle.

MRP: An abbreviation for Material requirement planning. This is a computerised package where the period wise requirement of FG is broken down into time phased requirement of its individual component/raw material. The inputs are the item master with lead time of individual items, and its stock norms. The MRP is particularly useful in multi product engineering industries which

involve thousands of component parts and different level of sub-assemblies are involved in the planning.

MTBF: Mean time between failure : This is calculated for a stated period of time .The MTBF indicates the mean value of the length of time between consecutive failures computed as the ratio of cumulative observed time to the number of failures under stated conditions.

MTTR: Mean time to repair: The sum total of the repair times divided by the number of times the repair activity was performed. This indicator is worked out individually for every machine to begin with for critical machines. The MTTR should show a decreasing trend over time.

MUDA: A Japanese term for non-value adding activities. Any process/operation/ procedure /activity which does not add value to the product is called a non-value adding activity or MUDA. MUDA is thus a word for WASTE. Non value adding activities are those for which the customer is not willing to pay. Material handling, inspection, storage, rework etc. are some glaring examples of non-value adding activities.

Multi Skilling: The situation where employees are trained in more than one set of skills. Multi skills are often imparted through organised programs and a multi skilled employee is very valuable and considerable productivity improvements can be achieved with this.

Multi Machine Handling: A situation where one man handle more than one machine through proper work planning, mechanisation and trouble detecting devices.

Multi Process Handling: A system of machine layout where machines requiring people at one location are placed in close proximity to reduce losses in handling and cut WIP.

6Ms: In the context of this Thesis, it means Men, Material, Machines, Measurements, Methods and Markets.

Non Value Adding Activity:. Any process/operation/procedure/activity which does not add value to the product is called a non value adding activity. Non value adding activities are those for which the customer is not willing to pay. Material handling, inspection, storage, rework etc. are some glaring examples of non value adding activities.

NDT: Non destructive testing: A diagnostic procedure for analysis of raw material and components. Generally used for analysis of elements in alloys/castings and checking of breaking strengths for components etc. Appropriate diagnostic instruments allow the testing to be carried out through non-destructive testing.

OEE: Stands for Original equipment effectiveness. It is a comprehensive measure of equipment's performance. which takes into account the following:

Availability (A measure of its time utilisation. Arrived at by subtracting the down time whether due to planned reasons or unplanned failures).

Performance (Measure of effectiveness in performance/underrated operation. Can be assessed by comparison with rated speed, loads etc.)

Quality Rate (Measure of the total production compared with the acceptable quality)

OEE of an equipment is arrived at by multiplying all the above three performance measures.

OTIF: On time Full Deliveries: A measure of performance of the logistics function. This term indicates 100 % achievement-of all deliveries in full acceptable quantities and all deliveries in the right time required by the customer.

PAF Model: A model of expressing Quality Cost. PAF Stands for Prevention, Appraisal, Failure cost.

Pareto Diagram (Analysis) : A Pareto diagram is a specialised bar chart showing relative frequency of events/categories in descending order and indicating incremental impact on % scale. The purpose of pareto diagram is to segregate VITAL FEW from TRIVIAL MANY.

Parlor Factory: A factory that can be comparable to a drawing room in a house, which is always spick and span. The visibility of the process should be of prime importance.

PDCA: Stands for Plan-Do-Check-Act a famous problem solving principle created by Edward Deming. The inherent principle is one of close feedback and improvement. Also known as Deming Philosophy.

P M Analysis: Phenomenon Mechanism analysis in which an adverse phenomenon is analyzed systematically by identifying the contributing conditions and their relationship with equipment, materials and methods. Corrective actions with standards are evolved and their frequency is specified.

POC: Price of conformance: See Cost of Conformance

POKA YOKE: A Japanese word for Fool proofing an operation to prevent mistakes. This is a useful principle in Zero Defect Management. Poka yoke promotes the use of such tools & jigs in which either a wrong component or part cannot be inserted or if inserted a warning system indicates the defect.

PONC: Price of non conformance: See Cost of Non Conformance

Prevention Culture: The set of basic values, perceptions & behavior to anticipate any abnormality or failure and take action to prevent its occurrence.

Process Mapping : Current job steps and tasks are depicted in flow chart form. Process mapping highiights, process name, objective, primary customers, current use of technology, cycle time, problems from workers point of view, detail of the work trigger points and end of process.

PULL System: This represents a manufacturing system where components are made only when required by the subsequent process. Also the goods are manufactured to meet specific customer requirement.

PUSH System: A system of manufacture (Conventional) where products are made to stock . The customer requirements are met from accumulated stock. Production is made in lots, which are generally high to optimise set up costs with inventory carrying costs.

QCDI / QCDIP: Stands for Quality, Cost, Delivery, Innovation and productivity the five major improvement areas for managers which are measurable. It is essential for quantitatively defining the targets under each head and measure the performance against that. For example Quality targets could be number of customer's complaints, reduction of number of non-conformities etc. Cost target can be, Chemical used per ton of product, Electricity used (KWH) per day/per ton etc. Delivery target could be lead-time for manufacture, Percentage improvement in On time full delivery etc.

QC Tools These are proven techniques for systematic gathering of data and arranging them in order to interpret trends, analysis and formulation of relationships between parameters. Basically QC tools necessitate arriving at facts based on systematic collection of actual data and its analysis. The commonly used QC tools are, Check sheets, Histograms, Scatter diagrams, Pareto analysis, Cause & Effect diagram, control chart

QFD: An abbreviation for Quality Function Deployment. This is a technique of optimising the process of developing and producing new products on the basis of customer need. QFD is a five-stage process that takes a design from customer requirements to production plan. The following are the stages:-

Identify customer needs. (May not be measurable)

Translate customer needs to technical specifications (measurable)

Convert technical specs to end product specs.

Design of process to produce

Plan production activities.

Quality: Totality of characteristics and features that bear on its capability to satisfy the stated and implied needs of a customer.

Quality Related Costs: The costs incurred in the design, implementation, operation and maintenance of an organisation's quality system, the cost of organisational resources committed to the process of continuous quality improvement plus those costs incurred owing to failure of the systems, products and services. Quality related costs arise from a wide range of activities (For example: sales and marketing, design, research and development, purchasing, storage and handling, production, delivery etc.) all of which may impinge on the quality of the product or service.

RCM: Reliability Centered Maintenance: Reliability is an indication of the ability of a product/service to perform a required function under stated conditions for the stated period of time. The maintenance function should also aim to ensure the reliability of the machine/equipment, which are attended to. The measures used to assess the reliability of maintenance is MTBF

Root Cause: For every symptom there can be several causes. The root cause is actually the most fundamental cause, which when removed, would lead to permanent solution. The solution is often arrived at asking 'Why' four to five times consequtively.

Scatter Diagram: A scatter diagram is a visual technique for showing the relationship between two variables (E.g. Speed & gasoline consumption , time worked and output)

If X and Y are two variables, collect sufficient pairs of data, scale the X and Y Axes and plot the data pairs as points on the scatter diagram and check for relationship.

It helps us to examine how strong the relationship is between two variables and determines the type of relationship (positive/negative etc.)

Seiri: It is a Japanese word for 'Organisation' of materials/equipment's/tools/information etc. in such a way that only those that are required are kept. Those that are not required needs to be segregated and disposed. Even amongst those that are required, they can be segregated into those required daily and those required periodically.

Seiton: A Japanese word for 'Arrangement ' which involves proper system of storing at the right place to ensure quick retrieval of the material or information. "A place for everything and everything in its place" is the principle followed.

Seiso: Again a Japanese word, which means ' Cleaning'. This refers to keeping the working place including the machines free from dust, dirt etc. this also involves a complete system including the method, means and frequency of cleaning.

Seiketsu : Means 'Standardisation' in Japanese. This involves complete documentation of procedures after standardising. This provides a proper basis for Segregation, arrangement and cleaning which can then be a continuous process. In the absence of standardisation, Segregation, arrangement and cleaning would remain adhoc activities.

Shitsuke: Stands for 'Discipline ' in Japanese. This deals with whole hearted participation of all the employees in following: Seiri, Seiton and Seiso based on the Seiketsu.

Self Managed Teams : Refers to operating teams well equipped with appropriate problem solving tools and are motivated to identify and solve problems and bring in improvements on a continuous basis. The self managed teams are clear about what is expected of them and are adequately trained to manage their work situation and to work effectively as a team. Self managed teams are now an integral part of organisations pursuing initiatives to reach world class standards.

Six Sigma: A program aimed at the near elimination of defects from every product, process and transaction. The concept of six sigma was introduced and popularised at Motorola in its quest to reduce defects of manufactured electronic products.

Six sigma technically means having not more than 3 to 4 defects per million opportunities in any process, product or service.

Skill Matrix: A matrix where individual employees are listed on one side and the different skills are listed in the other axis. Against the name of every employee the skills he is proficient with are marked. The matrix therefore indicates the multi skill abilities of employees. The proficiency level in each skill is again categorised. The skill matrix is useful in employee up-gradation, deployment on jobs etc.

SQM: Stands for Strategic Quality management: SQM is a Corporate strategy to achieve and maintain competitive edge. It requires taking a systematic look at the organization - looking at how each part interrelates to the whole process. In addition it demands continuous improvement as a way of life. Organizations pursuing SQM ensure, they have a Mission owned by all the employees, their product. market scope are well defined, Customer perception is well understood, common perception of quality throughout the organization and a culture which values customer and quality .

SMED: An abbreviation for Single Minute Exchange of Dies. The concept originated at Toyota Motors, Japan to minimize the change over time.

SPC: Statistical Process Control is a tool to measure the variability of a process and determine its capability to produce a particular product. A process consistently and predictably producing parts within 3 standard deviations of the average is considered in a state of statistical control. A process in statistical control means that there are no special (sporadic) causes in place. If there is a special cause in play, some of the process parameter values will go outside the control limit. However the natural variation within the process is referred to as common (Chronic) causes. These can be eliminated only through management action and improvement in the overall system. The process capability is measured by Process capability index (Cp). See Cp and C pk for further details.

Sporadic: Indicates a sudden abnormal occurrence in a otherwise stable system/process resulting in un acceptable outcomes of the process. Presence of Sporadic cause will result in a sudden major deviation, which is normally, visible easily. In a control chart presence of Sporadic cause can be found from observations falling either above or below the control limits.

Stratification: This is the method of grouping data by common points or characteristics to better understand similarities and characteristics of data. Examples of stratification: Material, vendor wise, size wise, age wise. machine, model wise, performance wise, size wise etc.

Successive Inspection: Worker on the second stage inspects product processed at the first stage. This is to prevent the possibility that the worker in the first does not compromise.

Supplier: The entity that has the capability to fulfill the needs of a customer in exchange of a price.

TAP: Technically Attainable Performance levels in terms of QCDIP, arrived at after a very thorough and exhaustive study of all the outcome and the minimum resources needed to achieve the same as well as the time that is needed for conversion and delivering the outcome. This is on the assumption that best possible standards are maintained in respect of every input, conversion process and delivering the output.

Toxic Emissions: Emissions either through solids, liquids or gaseous form which are poisonous and cause temporary/permanent partial or total damage when imbibed into human /or other living systems or vegetation.

UCL: Upper Control Limit: Indicates the limit, which is three times standard deviation above the mean value. In control charts the UCL is indicated by means of the horizontal line above the line representing the mean value.

Values: If vision is a picture of a desirable exciting future state, values are the guidelines that govern behavior of people and guide to achieve this future state. The values of an organization are reflected in the behavior of its senior managers.

Examples of values: Commitment to quality, teamwork, respects for the individual, continuous improvement.

Value Addition: It indicates the process/activity which results in enhancement of the value of the product/item on which the activity /process is being performed. The value addition is perceived from the customer's point of view.

Vendor Performance Rating: Vendor performance rating systems normally consider quality, price, adherence to delivery schedules, and lead time. Different weights are assigned to the factors as per need and the rating is done periodically say quarterly.

Visual Controls: Indicates a display of the variables/performance measures with a view to attract quick attention of the concerned individuals for taking the necessary corrective action. Visual displays also help as a communication medium. Visual controls such as fault indication lamps (also known as ANDON) draw the attention of operators manning a large area. A checklist is also an example of visual control system.

Vision: Vision is a dream created in our working hours of how we would like the organization to be. It can be described as a living picture of a future. It is inspired by the virtues we cherish. The Vision of an organization has to be a shared Vision amongst all employees. Vision can also be described as the galvanizing word picture of a desired future. It is where the company wants to be. An example of a novel Vision statement of Ritz-Carlton hotel chain , a winner of Malcolm Baldrige award : ' Ladies and gentlemen serving ladies and gentlemen' .In just seven words with great respect for the customer and great dignity for the employees, the fundamental purpose is to serve.

Voice of the Customer: A systematic way of ensuring that the development of product features, characteristics, and specifications, as well as the selection and development of process equipment, methods, and controls, are driven by the demands of the customer or market place.

Why - Why Analysis: A method of arriving at the root cause for a failure. The question why is asked five times for each cause that is put forth. It is a proven technique in arriving at root cause.

WCM Champions: Individuals who have been trained to practice the process, philosophy & methodology of World Class Manufacturing program.

WCOM: Stands for World Class office management. Application of concepts and techniques to build an office that is devoid of waste, delays, abnormalities, defect and is a model office where customer delight is the focus.

WIP: An abbreviation for Work in Process, which refers to inventory which, is in semi processed state. The raw material as it moves between different stages of manufacture is called WIP.

Work Analysis: Work analysis and cost analysis together form work process analysis, which is an essential step for re engineering.

Work analysis is further sub divided into process mapping and task analysis

Work Plan: This pertains to team working on specific projects. The work plan is a list of activities and times required accomplishing the Mission of a team.

ZAM: Stands for Zero abnormality management. An ideal state where the organization is completely free from any abnormalities.

Zero Defects: An organizational culture where everyone is striving for 100 % perfection in whatever they do. Everyone concentrates on measures to prevent defects from occurring. The culture is one of preventive rather than corrective. Right from the design stage emphasis is placed on defect prevention through measures such as Poka Yoke. Employees are trained in systematic problem solving techniques through team working and everyone is committed to getting things first time right.